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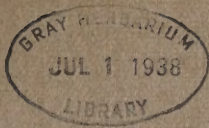
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YUCCAS OF THE SOUTHWESTERN UNITED STATES

PART ONE

By

SUSAN DELANO McKELVEY



PUBLISHED BY
THE ARNOLD ARBORETUM OF HARVARD UNIVERSITY
JAMAICA PLAIN, MASSACHUSETTS, U.S.A.

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INTRODUCTION

AFTER some years of study of the yuccas of the southwestern United States it is thought justifiable and wise (in order to obtain constructive criticism and additional information) to publish what has been learned of two sections of the genus in so far as these include species growing in the region specified. Certain new characters for use in determining these species are offered and their ranges are more precisely defined than hitherto. The work has consisted of a review of the literature, the study of the author's collections and those that are found in the important herbaria (13 major collections have been examined) and a large amount of field work.

The yuccas have been much cultivated in England and on the continent of Europe, to a lesser degree in this country, and many horticultural forms and hybrids are mentioned in the literature; unless of importance from the standpoint of nomenclature these cultivated plants are not discussed to any extent since they offer little of value to an understanding of our native material; moreover, the origin of such garden plants is for the most part uncertain.

Important collections have been discussed at length. The oldest and most comprehensive are in the Torrey Herbarium (N. Y. Botanical Garden), the Engelmann Herbarium (Missouri Botanical Garden) and the U. S. National Herbarium. Hitherto, for the older species authors did not designate types; their selection now has necessitated an understanding of the routes traveled by the early explorers; material, upon receipt often divided among several botanists, has had to be located (some sheets mentioned in the literature have not yet been found) and assembled; in many instances material from different localities or gathered by different botanists has not only been mounted upon one sheet but has become inextricably mixed, making a positive separation impossible; old field labels of the original collector have been changed by notations added subsequently and often uninitialed. To unravel these snarls has been difficult and the conclusions have required explanation. If only to assist some future student of this genus it has been thought well to discuss all such tedious details at length and to leave, as it were, an inventory to date.

It is believed that the yuccas can best be understood when growing in their native habitat. No attempt has been made to describe aspects of the plant still unknown to the writer; she hopes eventually to complete inadequate descriptions by additional field work.

The importance of a field as distinguished from a "closet" study of these plants has become increasingly apparent. Yet inaccessibility, great distances, uncertainty as to season of bloom (of which little definite information has been or can be given since it differs from year to year), coincident bloom of species far removed from each other geographically, absence of flowers or of fruit in one year necessitating another visit in a subsequent season, have all required planning and patience. One comes to the discouraging realization that, in a country broken by innumerable mountain ranges, it will be very long before the territory where these plants are abundant can be thoroughly explored;

however, most yuccas appear to be of a fairly or even very wide range so that it is improbable that there exist many undiscovered species confined to limited localities.

The area where this study has been made extends, roughly speaking, from central Texas (west of a line running from Fort Worth and Dallas through Austin to Corpus Christi on the Gulf of Mexico) west to the Pacific Ocean and from the Mexican border as far north as the southern portions of Nevada, Utah and western Colorado. It is not even inferred that such a vast territory has been covered, even superficially, although eight trips to the southwest have been made since 1928; five were for the sole purpose of studying *Yucca* and allied genera and were made in April-June, 1929, December, 1929-April, 1930, April-June, 1931, March-May, 1932, April-June, 1934; also, in the summer of 1935, O. E. Hamilton made a trip to secure important material. An automobile proved satisfactory as far as reaching most localities was concerned and in the main good fortune was experienced in finding the plants in flower and in fruit, often more than once; when material was lacking friends in a region at times have supplied the need.

In practically all instances flowers and fleshy fruits were preserved in solution. The genus can be understood only imperfectly from pressed specimens even of the best, for with drying great shrinkage occurs and such distinctive organs as pistil and filaments lose their swollen and characteristic form; even photographs do not adequately interpret plant or inflorescence but many were taken and have served to keep the originals in mind. The inadequacy of herbarium material is understandable, certainly in so far as the two sections here discussed are concerned; for it is always difficult, often painful, to remove such leaves in their entirety and to secure flowers and fruit from the arborescent plants requires a ladder; also, because of the bulky, fleshy character of foliage and inflorescence considerable space and infinite patience is needed to produce good specimens.

In addition to herbarium material and photographs the moths associated with *Yucca* were procured when possible; several thousand were collected and Dr. August Busck of the U. S. National Museum spent considerable time in their study; he has kindly suggested that the writer publish his conclusions and she hopes to do so in the second part of this paper. Other insects frequenting the yuccas were occasionally obtained and their determinations were supplied by Dr. Harold Morrison of the Division of Entomology, U. S. Department of Agriculture, and by his associates.

Material for a cytological study of *Yucca* and some allied genera, notably *Agave*, was obtained for Dr. Karl Sax¹ of the Arnold Arboretum.

Keys and descriptions have at times proved inadequate when confronted with the living plant. Engelmann, the first to monograph *Yucca*, noted (1873) that herbaria offered little and incomplete material and that, in cultivation, individual peculiarities had been propagated "a thousand and a thousand fold in the course of a century" so that little light could be obtained from the study of cultivated specimens; he wrote: "The difficulties are increased by the fact, that. . . in their native homes these plants vary remarkably in the structure and form of even their more important organs; and until fuller examination of native forms can be had we must remain in considerable doubt as to the limits of species." He discussed the genus in great detail and his conclusions as to the difficulty of discovering specific characters have been more than corroborated; in fact "fuller examination of native forms" has increased, rather than diminished, appreciation of the plant's instabilities; the inconstancy which Engelmann noted, practically throughout, makes it obvious why any characterization of groups or of species must be understood to include reservations as to exceptional plants.

As far as the yuccas are concerned J. G. Baker's *Synopsis of Aloineae and Yuccoideae*

¹ Jour. Arnold Arb. 14: 76, t.55.1933.

(1880) appears to have been based to a large extent upon Engelmann's writings; he seems to have done no field work.

Dr. William Trelease has studied *Yucca* in the field and his monograph (1902) is the most recent and authoritative treatment of these plants.¹ Unfortunately in some instances he must have lacked comparable material with the result that juxtaposition of his characters is at times impossible; and (as was, and as is still, unavoidable) vast areas abounding in *Yucca* were unexplored; some regions especially have proved perplexing, representing as they do a meeting-ground of species of far wider range than formerly supposed.

Chiefly upon floral characters Engelmann (1873) divided *Yucca* into the subgenera *Euyucca* and *Hesperoyucca*; the first, mainly upon fruit and habit characters, he broke into three sections, called in 1871 *SARCOCARPA*, *CLISTOCARPA* and *CHAENOCARPA* which he changed in 1873 to *SARCOYUCCA*, *CLISTOYUCCA* and *CHAENOYUCCA*; the second subgenus included one species, *Y. Whipplei*. One plant, doubtfully classified as a *Yucca* by Torrey and as an *Aloe* by Gray, he had placed (1871) in a new genus *Hesperaloe*.

Baker (1880) included, with other genera, in his tribe Yuccoideae, *Yucca* and *Hesperaloe*, separated on floral characters; he retained Engelmann's subgenera *Euyucca* and *Hesperoyucca* as well as his sections *SARCOYUCCA*, *CLISTOYUCCA* and *CHAENOYUCCA*, — the classification based on fruit-characters; the *Euyucca* he subdivided into species groups based on leaf-characters, with three sections, *SERRULATAE*, *INTEGRIFOLIAE* and *FILIFERAE*, and subdivided these groups upon habit of plant, breadth of leaf, etc. It was not until 1892 that Baker placed *Y. Whipplei* in the genus *Hesperoyucca*.

Trelease (1902) in his revision of the group Yuccaceae, included five genera, *Hesperaloe* Engelm., *Hesperoyucca* (Engelm.) Baker, *Clistoyucca* (Engelm.) Trel., *Yucca* L. and *Samuela* Trel. He divided *Yucca* into three sections, *CHAENOYUCCA*, *HETEROYUCCA* and *SARCOYUCCA*, the first and last based on Engelmann's sections, the second new and including one species from the Atlantic Coast and three known only from cultivated material; our present study is not concerned with this section. Nor is it concerned with *Hesperaloe* which produces a capsular fruit.

The two most comprehensive and recent treatments of the monocotyledons are by K. Krause and J. Hutchinson. The first (Engler and Prantl, Nat. Pflanzenfam. **15a**: 351–354. 1930) does not depart from Trelease's classification either as to genera included in Yuccaceae or as to the sections of *Yucca*. The second (Fam. Flowering Plants, **2**: 151–153. 1934) places the tribe Yuccaceae in a new family Agavaceae; this interesting but radical and controversial change in classification need not be discussed here.

The writer believes that the genera *Hesperoyucca*, *Clistoyucca* and *Samuela* should be included in the genus *Yucca* and that those plants producing indehiscent fruit should be referred to the sections *SARCOCARPA* Engelm. and *CLISTOCARPA* Engelm. The present study deals only with the sections *SARCOCARPA* and *CLISTOCARPA* and only with such species as occur in the southwestern United States. *SARCOCARPA* is divided into three series, *Faxonianae*, *Baccatae* and *Treculeanae*. The first two series are characterized by long pistils, at anthesis 4.5–8.25 cm. in length. The first series, *Faxonianae*, comprises the two species separated by Trelease as *Samuela*. The second series, *Baccatae*, includes four species (one of which is first described here) closely related to *Y. baccata*. The third series, *Treculeanae*, is distinguished from the former two by a short pistil, at anthesis 2–3.25–(rarely, and only in one species) 4 cm. in length; it includes four species, all arborescent when mature. The section *CLISTOCARPA* includes the Joshua-tree, *Y. brevifolia* Engelm.

The characters upon which Trelease separated the genera *Samuela* and *Clistoyucca*

¹ G. Molon's monograph, *Le Yucche*, published in Italian (1914), was apparently based on Trelease's work as far as the spontaneous plant is concerned.

from *Yucca* merely represent (to the writer) modifications of those found in true *Yucca*, — the plants no more worthy of generic separation than, for instance, the two main groups of *Yucca* which produce in one instance baccate, in the other capsular fruit and which, in respect to foliage, inflorescence, flowers and fruit, are separable at a glance. Of *Samuela* Trelease wrote that “though of the general habit, floral plan and fruit and seed characters of the baccate *Yuccas*, they are distinguished in having the perianth distinctly tubular and gamophyllous below, with the stamens becoming free only at its throat . . .” This gamophyllous, somewhat tubular perianth appears, modified, in the shorter, more cup-shaped base found in the *Baccatae* series in which the base of the flower (or united portion of perianth) merely extends for a shorter distance above the base of the ovary; in *Y. baccata* and its allied species the filaments are attached from the base to the top of this cup-shaped base and “become free” at a similar point, proportionately, to those of *Samuela*. In short, the characters found in *Samuela* represent merely the culmination of tendencies and characters evident in the series *Baccatae*.

Of *Clistoyucca* Trelease states that “it differs in its collective flower and fruit character about as much from typical *Yuccas* as does *Hesperoyucca*.” To the writer it does not appear to be distinct (excepting in the dry and spongy character of its fruit) in what might be considered a generic character. Indeed, a very similar fruit is said to be produced in *Y. gloriosa* of the Atlantic seaboard, a species which Trelease includes in his section *HETEROYUCCA*; the writer has only seen dried material of *Y. gloriosa*. It seems reasonable to suppose that the fruits of *Y. Whipplei* (Baker's *Hesperoyucca Whipplei*) and of *Y. brevifolia* (Trelease's *Clistoyucca brevifolia*) represent modifications, the former of the common capsular fruit, the latter of the common baccate fruit; both occur in much the same geographic region and grow under extremely arid conditions; whether they represent transitions between the capsular- and fleshy-fruited groups of *Yucca* or perhaps older or younger forms of these is not known.

For the above reasons the genera designated by Trelease are not retained. Sargent (1905) put back *Samuela Faxoniana* into *Yucca*, but Shafer and Standley have followed Trelease in treating this as a *Samuela*. *Clistoyucca* has been adopted by Rydberg but Jepson, Abrams and certain other botanists have failed to make the transfer.

Eight species belonging, within the limits of this study, in the sections *SARCOCARPA* and *CLISTOCARPA* were recorded by Trelease from the southwestern United States; six of these were of the genus *Yucca*, one of the genus *Samuela* and one of the genus *Clistoyucca*. Since Trelease's monograph was published his *Samuela carnerosana*, then known only from Mexico, has been found in the United States, — Mr. V. L. Cory first writing (1930) of its occurrence in Brewster Co., Texas, close to the Mexican border. In addition to these nine species two, belonging to the series *Baccatae*, have been distinguished, one, *Y. Thornberi* McKelvey, published in 1935, the other *Y. confinis* McKelvey here described. Also separated here for the first time are two varieties, *Y. baccata* var. *vespertina*, *Y. Treculeana* var. *succulenta* and one form, *Y. Torreyi* f. *parviflora*; a dwarf variety of the Joshua-tree, *Y. brevifolia* var. *Jaegeriana* McKelvey, was published in 1935. *Yucca Treculeana* var. *canaliculata* (Hooker) Trel., for reasons given under that species, is reduced. The two sections here treated embrace (in the southwestern United States) eleven species, three varieties and one form.

In 1935, for reasons of priority the species *Y. Treleasei* MacBride was given a new name, *Y. arizonica* McKelvey. It has been found that the name *Y. mohavensis* Sarg. must be replaced by *Y. schidigera* Roetzl; the writer regrets the need for this change since Sargent's epithet was well chosen, facile to use and well established. The name *schidigera* is derived from the Latin *schidia* — splinter or chip of wood; the fibres which separate

along the leaf-margins of this species are often coarse and broad, so that the name is appropriate although other species, notably *Y. baccata*, produce similar fibres.

Yuccas with fleshy, indehiscent fruit occur, intermittently, throughout the greater part of the southwest, only ceding to those with capsular fruit regions of extreme aridity such as occur about the Panhandles of Texas and Oklahoma, and in certain desert areas of these and other states. *Yucca baccata* appears to be the most wide-spread, extending from the mountains of the northeastern Mohave Desert of California, from southern Nevada, Utah and southwestern Colorado, south and southeast across the northern half of Arizona and the greater part of New Mexico into the Big Bend region of western Texas. In the northwestern part of this range the typical plant is mainly replaced by the variety *vespertina*. A plant of the higher elevations, *Y. baccata* is most often found in association with juniper and pinyon-pine. The three other species allied to *Y. baccata* seem to be more localized and are mainly restricted to southcentral and southeastern Arizona although probably extending into adjacent southwestern New Mexico. Two species of the *Treculeanae* series extend across the greater part of southwestern Texas; from, generally speaking, San Antonio to Corpus Christi on the Gulf of Mexico, *Y. Treculeana* spreads westward and, from Uvalde Co. on to Devil's River, Val Verde Co., adjoins or interlocks with the eastern limits of *Y. Torreyi* which, westward, replaces the more eastern species and extends across southwestern Texas into southeastern New Mexico as far, certainly, as the Rio Grande River. As here differentiated *Y. Treculeana* in typical form is small-flowered; its variety *succulenta*, which seems to be mainly if not entirely confined to a limited area in the eastern part of the species' range, produces fewer but larger flowers; typical *Y. Torreyi* on the other hand is treated as large-flowered; its form *parviflora* is found practically throughout the range of the species although less common. The ranges of the two remaining members of the *Treculeanae* series are separated not only from the two Texan species but from each other; *Y. Schottii*, which prefers the protection of trees and the higher elevations, is confined to southeastern Arizona and adjacent southwestern New Mexico; *Y. schidigera* (*Y. mohavensis*) is of a more western and more extensive range, occurring in many parts of southern California, in northwestern Arizona and in southern Nevada. The Joshua-tree, of the section *CLISTOCARPA*, is found in and adjacent to the Mohave Desert of California, in northwestern Arizona, southern Nevada and extreme southwestern Utah; its variety *Jaegeriana* from the eastern Mohave Desert extends into southern Nevada and Utah; in some regions it entirely replaces the better known plant.

In the delimitation of the series and descriptions of species terms are used which need definition; one such is "base of the flower." The flower, when no fruit is formed, falls from the inflorescence; the pedicel to which it was attached remains upon the inflorescence in ligneous condition; articulation, or the joint between flower and pedicel, under normal conditions, is similar in all species of *Yucca*. Baker (Gard. Chron. n.s. 6: 196. 1876), writing of *Y. Whipplei*, stated: "But the structure of the flower is most distinct from all the species we know already. In the first place the pedicel has a distinct joint like that of a *Dracaena* or *Cordyline*, the short upper node being so much thickened that it looks at first sight like the inferior ovary of an *Agave*." The "short upper node" which Baker mentioned is floral in character, *not* a part of the pedicel; in many species, sometimes short, again longer, it is present and is often more conspicuous in the fruit than in the flower since then it may be considerably enlarged. Certain groups or species seem to be distinguishable by the form into which, at base, their perianth-segments unite to each other; for instance in *Y. Torreyi* they are free for practically their entire length, uniting above the pedicel into a gibbose base, what Baker calls the "upper node" scarcely dis-

tinguishable; in the Baccatae series the corolla-segments are united from slightly above to below the base of the ovary into a base of cup-shaped or short-obconical form; between this and the pedicel there is frequently present a short, contracted prolongation here designated as stipitate; quite often in *Y. baccata* var. *vespertina* this stipitate base is considerably prolonged and funnel-shaped; it is often extremely long in *Y. Whipplei* and Baker's "short upper node" represents such a prolongation of the perianth.

The writer's differentiation of the parts of the pistil (ovary, style, stigmas) should be explained. Dr. Trelease did not define what he included in the term style but it is apparent from his descriptions — in which he contrasted the color of ovary and style and commented upon the swollen or non-swollen character of the style at its base — that he considered as style the always papillose portion of the pistil which extends between the glabrous ovary and the three terminal free divisions or stigmas. Engelmänn (1873) wrote: "The always glabrous ovary is either obtuse and abruptly terminated by the stigma . . . or it is gradually attenuated into a conical or prismatic glabrous style, sometimes as long as the ovary itself . . . which towards the tip ends in the stigmas. This style is an organ of great variability in length and thickness, and may or may not be present in forms of the same species. Stigmas we conventionally call the terminations of the three carpels, which are distinguished from the ovary and style by their coating of transparent oval or globose epidermal cells . . . The three stigmas, emarginate or bilobed at the summit, are more or less united, and form a tube . . ." Yet Engelmänn does not seem entirely consistent for he wrote of *Y. Whipplei*: "*Hesperoyucca* has an obovate ovary . . . crowned by a shorter or longer, sometimes filiform style, bearing a very peculiar, large . . . stigma, beset with long filiform papillae;" what he called the "filiform style" of *Y. Whipplei* is covered with short papillae and not glabrous and should, according to his own differentiation, be considered as the lower portion of the stigmas. Since the definition of style and stigmas, as Engelmänn stated, is "conventionally" determined, and since he himself occasionally departed from the conventional use of the terms, it seems justifiable to follow Trelease (who did not use the terms in their strict sense) since his work is the most recent and authoritative. As here understood the ovary is always glabrous (only one specimen of *Y. Treculeana*, *McKelvey 1704*, showed papillae or even fleshy hairs extending for a short distance down the neck of the ovary or below the papillose style); it is variable in form; in some species it tapers rapidly or gradually from an enlarged base to the style; in others its major, lower portion may be oblong-cylindric,¹ its minor, upper portion gradually or abruptly tapered and giving the effect of shoulders and neck; again the ovary may be more nearly fusiform. In the two sections here treated, ovary, style and stigmas are much the same color at anthesis, — cream, or greenish cream (in *Y. brevifolia*); but with the development of fruit the ovary assumes at once a darker, greener hue than the upper portions of the pistil; in these sections, since the basal lobes of the style are but little swollen, the distinction between ovary and style may not always be well-defined and a glass necessary to reveal the very small tips terminating the papillose surface of the style at its base. (In the capsular-fruited yuccas the style is often better differentiated in color, a darker green than the ovary at anthesis, and in form, — considerably swollen near the base or in certain species terminating in long-acuminate, conspicuous tips which extend down over the upper portion of the ovary.) In the species here treated there appears to be a very slight difference in color between the style (cream-white) and the stigmas (pure white). The papillae which cover style and stigmas seem to be much the same in form and size in any one species; it is possible that there may be

¹ Strictly speaking both ovary and style instead of being truly cylindric show in cross-section 3 or 6 well- or ill-defined lobes between the lines of the primary and secondary dissepiments.

some difference in their extension downward on the inner surface of the stigmas in the different species.

It is curious that little, if any, mention of the leaf-base appears in the literature, — probably because so few leaves in herbaria boast more than the blade. Yet the sections SARCOCARPA and CLISTOCARPA can be distinguished at once by the color and size of leaf-base; in SARCOCARPA its epidermis is red (ranging from brilliant to dark crimson); this color is clearest where the base is protected from light by adjoining ones, along the margins, where exposed to light and weathering, it turns to brown, and at point of attachment to the stem is often cream or greenish white; in CLISTOCARPA the epidermis is cream or greenish cream, along the margins pale brown or yellowish, at union with the stem white, commonly marked with a tiny crimson line. The breadth of a leaf-base presumably increases as the stem to which it is attached enlarges in diameter; in SARCOCARPA the base is bigger than in any other section of *Yucca* and in some species seems to be extremely broad proportionately to its median length; but how much reliance can be placed upon this as a specific character is uncertain because of the small amount of material available for comparison and what exists collected at random rather than for the purpose of comparison, — taken from stems of similar diameter, etc. Such data as has been assembled as to size and form of base is included in the specific descriptions. In both sections the epidermis is glossy, thin, strong (except along the margins where it becomes thinner and more brittle) and, as the leaf-base increases in size, becomes variously fissured or cracked, the fissures mostly running longitudinally but occasionally across. Every leaf-base, because of the pressure of adjacent ones, is, in the section SARCOCARPA, always more or less conspicuously thickened; this thickening is nearly universal just at and below the union of base and blade (present here in part because the substance of the leaf is forced into a smaller compass at this point) and where present the base is lenticular or plano-convex; another thickening frequently occurs below this point (presumably because of the pressure from within and without of adjacent leaves); it is most often apparent on the outer surface, the base there lenticular, concavo- or plano-convex; such thickenings become more pronounced on old leaf-bases (on juvenile ones they may be scarcely noticeable); they are variable in form and have, to date, proved of no use specifically. In CLISTOCARPA such thickenings are far less pronounced at all stages and at times are confined to the region where base and blade unite; since the base is less thickened it is also less fissured in this section. In both sections the margins of the leaf-base narrow in gradual or abrupt convex curves from their union with the stem to their union with the blade, the form of the curve changing as the base broadens. The base is attached not only to the stem but also to those bases which are adjacent (whether through pressure or because of the interlocking of fibres the writer does not know); but in CLISTOCARPA (and in the capsular species) one may, after cutting longitudinally through a head of leaves, peel off the entire cluster from a stem and remove, as an entity, a whole circle or circles of leaves; the same may be true of SARCOCARPA but the writer has never attempted the task!

Nor are the leaf-blades of these two sections of *Yucca* to be confused; in SARCOCARPA the blade is large, coarse (although in some species less so than in others), with fibrous margins, the fibres separating or not separating according to the species, and of a dark green color; before this separation a leaf-margin varies from acute to really sharp (at times somewhat uneven or as if toothed), after the fibres have become free it is thicker, somewhat truncate; often for a time the margin is dark crimson; in CLISTOCARPA the blade is small, with yellowish, more or less horny, always serrulate margins, and of a pale sage-green color; in both sections the blade in form shows a tendency to be plano-convex for

a long or short distance above its union with the base, above to the apex more or less concavo-convex; in CLISTOCARPA it tapers from base to apex, in SARCOCARPA it varies in form in the different species, some blades tapering for their entire length, most, however, being slightly or considerably broadened at or about the middle.

All species of these two sections produce paniced inflorescences which vary in form (this due to number, length and position of branchlets and to length of racemose tip, etc.) and in position in relation to foliage (this dependent upon the length of the scape); while within a species this form and position shows some, even considerable, variation yet there is sufficient stability to permit differentiation along these lines. In SARCOCARPA the inflorescences (rhachis, bracts, flower-buds and occasionally the expanding flowers) are often tinged with varying shades of reds and purples, this coloring fading gradually in most instances; in CLISTOCARPA this coloring is far paler and is not always present. Only *Y. Schottii*, of the species under discussion, produces a characteristically puberulous inflorescence although glabrous ones have been collected by others than the writer; pubescence in the other species is rare and is confined to the pedicels or base of the flower mainly; only one specimen of *Y. carnerosana* (from Mexico) was noted as conspicuously pubescent. No specific characters have been found in the pedicels which vary, even on the same inflorescence, and which are terete to flattened, slightly enlarged (at times somewhat 3-sided) as they approach the flower; the longest occur along the rhachis or at the base of the branchlets, of the lower ones especially; at first erect they eventually spread or become decurved near the middle or close to the flower or fruit. Large, pale green or cream-colored bracts form a conspicuous part of the inflorescence of all yuccas of these two sections; in SARCOCARPA before or at anthesis they may be more or less tinged, as has been noted above, with shades of reds and purples; in CLISTOCARPA these shades are paler or may not appear at all. At the base of the scape the bracts, in all species, are very similar to the juvenile leaves in the center of a cluster, with slender, ill-defined base and blue-green, pale blade; upward on the scape they change gradually or rapidly in form, the lower portion (or base) becoming longer, broader, thicker and more leathery, the upper leaf-like portion diminishing in length and eventually disappearing, the tip of the bract finally spinescent or smooth; this transformation from leaf to more or less triangular-ovate bract occurs in large part within the limits of the scape but occasionally is not complete until within the inflorescence proper; on the flowering portion these bracts are present at the base of each branchlet (which they have protected in the bud), becoming upward smaller in all proportions (though little changed in form) and in texture thinner, less leathery and more fragile; a small white or cream-colored fragile bract of somewhat triangular form is present at the base of each pedicel (it has enclosed the flower-bud) and — just as the bracts at the base of the branchlets become reduced in size on the upper part of the inflorescence — so these become smaller from base to tip of branchlet; a still smaller and more fragile bractlet is occasionally present also at base of the pedicel. Those bracts with leafy tip dry first near the base while those bract-like throughout dry from the tip downward; the fact that all become fragile and brittle undoubtedly explains the fact that so few, and these rarely intact, are found in the herbarium. As was said of the leaf-base, more bracts must be studied before specific characters based upon their form, texture and numbers in these two sections can be considered trustworthy. Certain parts of the flower have been discussed but a word should be said of the corolla. In CLISTOCARPA this is distinct in color, form and manner of expansion these distinctions discussed under that section. In the series Faxonianae (of SARCOCARPA) it is distinct in color and form and at anthesis expands to the top of the united portion or base. In both Treculeanae and Baccatae series the corolla is, basically, cream-colored;

while the corolla-segments average far longer in the last series than in the first yet in both *Y. Treculeana* and in *Y. Torreyi* we find flowers which approach in size the smaller ones of *Y. baccata* and its allied species and which are campanulate as in the Baccatae series. In all species of SARCOCARPA the corolla-segments vary enormously in breadth and shape so that no specific characters based upon them hold good; the segments of the outer row generally show more thickening along the middle than those of the inner row (this thickening when pronounced below, producing the gibbose base characteristic of several species, when pronounced above, the hood-shaped apex) and indeed are slightly thicker throughout, as a rule a trifle narrower, and along the margins show less tendency to the unevenness or denticulation occasionally found in the petals; all are glossy, waxen and, where much thickened, brittle and readily snapped; it is not unusual to find short, fleshy pubescence upon the hood-shaped apex, this at times extending downward for a short distance along the margins.

In the citation of specimens and in the text herbaria are indicated by the following abbreviations: AA (Arnold Arboretum); ACC (Agricultural College of Colorado); CA (California Academy); CU (University of Colorado); G (Gray Herbarium); M (Missouri Botanical Garden); N (New York Botanical Garden); P (Philadelphia Academy of Natural Sciences); PO (Pomona College); S (Stanford University); UC (University of California); UT (University of Texas); W (United States National Herbarium).

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SUBDIVISIONS OF YUCCA L.¹

FRUIT INDEHISCENT

Section 1. SARCOCARPA Engelm. (p. 16).

Series 1. Faxonianae, n.ser. (p. 16).

1. *Y. Faxoniana*
2. *Y. carnerosana*

Series 2. Baccatae, n.ser. (p. 29).

3. *Y. baccata*
Y. baccata var. *vespertina*
4. *Y. confinis*
5. *Y. arizonica*
6. *Y. Thornberi*

Series 3. Treculeanae, n.ser. (p. 65).

7. *Y. Treculeana*
Y. Treculeana var. *succulenta*
8. *Y. Schottii*
9. *Y. schidigera*
10. *Y. Torreyi*
Y. Torreyi f. *parviflora*

Section 2. CLISTOCARPA Engelm. (p. 118).

11. *Y. brevifolia*
Y. brevifolia var. *Jaegeriana*

FRUIT DEHISCENT

Section 3. HESPEROYUCCA Engelm.

Section 4. CHAENOCARPA Engelm.

¹ This table and the next give the author's ideas of the principal groups within the genus and the relation of the indehiscent, baccate species to the dehiscent, capsular species of *Yucca* which will be treated in a later paper.

KEY TO THE SPECIES OF SECTIONS SARCOCARPA AND CLISTOCARPA

- A. Fruit fleshy, eventually pendent; leaf with large, coarse, sword-like blade and dark, red base; inflorescence (including scape) 0.50–1.5 m. in length or even more; perianth-segments at anthesis expanding similarly in the two series and to their point of union at base; seed thick.
Section: SARCOCARPA
- B. Pistil long, 4.5–8.25 cm. in length at anthesis; the united portion of perianth (or base of flower) extending perceptibly above base of ovary; filaments adnate to base of perianth to a point well above base of ovary; fruit 7.5–10.25 cm. (in nos. 1 and 2), 13–18–even 23 cm. in length (in nos. 3, 4, 5 and 6).
- C. Perianth-segments united into a long, slender, somewhat obconical or nearly tubular base 1.2–2.5 cm. in length; filaments free from each other at insertion, their free portion unequal in length in the two series, their adnate portion not appearing (with removal) to extend to the base of the ovary; ovary fusiform; flowers pure white, with a distinctly sweet and pleasing fragrance; plants commonly with one, only occasionally with several stems; stems 3–4.5 m. or even more in height; fruit 7–10 cm. in length, 2.5–4.0 cm. in diameter. (Series: Faxonianae)
- D. Inflorescence proper not raised for its entire length above the leaves (scape 0.3–0.6 m. in length), at first tapered above and below, at length broadest near the base, with 35–40 branchlets; inflorescence (including scape) averaging 1–1.3 m. but occasionally 2 m. in length; perianth-segments only rarely united for more than 1.2 cm.
1. *Y. Faxoniana* p. 18
- DD. Inflorescence proper raised well above the leaves (scape 0.75–1.0 m. in length), nearly spherical or eventually nearly cubic, with 20–30 branchlets; inflorescence (including scape) averaging 1.5–2 m. in length; perianth-segments commonly united for 2 cm.
2. *Y. carnerosana* p. 24
- CC. Perianth-segments united into a short, stoutish, somewhat obconical or cup-shaped base 0.7–1.2 cm. in length; filaments united to each other at insertion, their free portion equal in length in the two series, their adnate portion appearing to form a flat, collar-like band which extends from slightly above to below the base of ovary; ovary tapered from base to style or its major lower portion nearly oblong-cylindric; flowers cream to pale greenish cream, often much colored with reddish purple without, with an earthy odor; fruit commonly 12–17 but occasionally even 23 cm. in length, 4–6.5 cm. in diameter. (Series: Baccatae)
- D. Plants acaulescent or with short procumbent stems, solitary or forming small open clumps; in the variety of no. 3 the clumps are often dense and involved; clavate tip of filament turning at a more or less conspicuous angle to the lower portion at anthesis.
- E. Inflorescence fleshy at anthesis, short, 0.50–0.75 m. in length (including scape); scape 10–15 cm. in length, straight; inflorescence proper nearly buried in foliage, slender below, considerably broadened above, the extreme top somewhat flattened; leaf with a broadened, often twisted blade the margins of which separate, especially near apex, into coarse, broad and flattened fibres at times suggestive of fine wood-shavings; head of leaves asymmetrical, broadest near base.
3. *Y. baccata* p. 30
- EE. Inflorescence ligneous at anthesis, long, 1–1.3 m. in length (including scape); scape 30–45 cm. in length, often flexuous; inflorescence proper raised above foliage for about $\frac{1}{2}$ its length, slender below, slightly broadened above, the extreme top acute to rounded; leaf with a scarcely broadened, straight blade the margins of which separate into many rather long, fine fibres; head of leaves symmetrical, constricted near base, broadest above.
4. *Y. confinis* p. 49
- DD. Plants caulescent with tall, erect or erect-ascending stems 1–2 m. in height, forming large, crowded clumps; clavate tip of filament little angled in relation to lower portion at anthesis.

- E. Inflorescence ligneous at anthesis, many-branched; inflorescence proper raised above foliage for greater part of its length, slender below, broadest near top; leaf commonly short, with a slightly broadened, rarely straight blade which is plano-convex to about middle and thence to apex concavo-convex; free fibres plentiful along margins of young but practically lacking along those of old leaves; fruit averaging 4 cm. in diameter; bracts in texture similar to a thick, tough paper and somewhat persistent.

5. *Y. arizonica* p. 53

- EE. Inflorescence fleshy at anthesis, few-branched; inflorescence proper raised above foliage for $\frac{1}{4}$ – $\frac{1}{2}$ of its length, ellipsoidal, broadest near middle; leaf averaging long, with a commonly lanceolate, straight blade which is concavo-convex for greater part of its length; free fibres lacking along margins of young but plentiful along those of old leaves; fruit averaging 5 cm. in diameter; bracts in texture somewhat fleshy, soon fragile, brittle.

6. *Y. Thornberi* p. 58

- BB. Pistil short, 2–3.25–(rarely, and only in no. 10) 4 cm. in length at anthesis; the united portion of perianth (or base of flower) scarcely extending above, commonly reaching only below, or to, the base of ovary; filaments attached only to very base of perianth; fruit rarely exceeding 10.25–11.5 cm. in length, 2.5–3.25 cm. in diameter; in no. 10 occasionally 12.75–14 cm. in length, 5 cm. in diameter. (Series: Treculeanae)

- C. Margins of leaf without free fibres; ovary short, slender for its length, not exceeding 0.7 cm. in diameter at anthesis.

- D. Inflorescence commonly glabrous, many-branched (branchlets about 25 or more in number); scape averaging 30 cm. in length; leaf-blade thick, more or less scabrous on outer surface; flowers produced in March and early April; southcentral Texas.

7. *Y. Treculeana* p. 67

- DD. Inflorescence commonly puberulous, few-branched (branchlets about 15–25 in number); scape nearly lacking or less than 20 cm. in length; leaf-blade thin, smooth on both surfaces; flowers produced in July or August; southeastern Arizona and adjacent southwestern New Mexico.

8. *Y. Schottii* p. 82

- CC. Margins of leaf with detaching fibres; ovary short, stout for its length, 0.7–1.2 cm. in diameter at anthesis.

- D. Ovary abruptly tapered from base to style or its major lower portion oblong-cylindric, its minor upper portion abruptly tapered to style; style extremely short, about as broad as long, with parallel sides; stigmas erect or, more rarely, spreading abruptly above the style; the united portion of perianth (or base of flower) little thickened, slightly gibbose or more often flat or saucer-shaped; leaves averaging short (0.3–0.6 m. in length); leaf-blade often considerably broadened near middle and thence tapered to apex; spine rather long; southern California, southern Nevada and northwestern Arizona.

9. *Y. schidigera* p. 92

- DD. Ovary gradually tapered from base to style; style and stigmas forming one vase-shaped unit (spreading from union with ovary to tips of stigmas); the united portion of perianth (or base of flower) much thickened, conspicuously gibbose; leaves averaging long (about 1 m. in length); leaf-blade commonly tapered from base to apex, only slightly if at all broadened near middle; spine rather short; Rio Grande Basin.

10. *Y. Torreyi* p. 104

- AA. Fruit spongy or dry, spreading; leaf with small, fine, stiletto-like blade and cream or greenish base; inflorescence 0.5 m. or less in length (including scape); perianth-segments at anthesis expanding differently in the two series, the outer scarcely if at all, the inner for about half their length; fragrance of flowers distinctive, very similar to that of the common field-mushroom; seed thin.

Section: CLISTOCARPA

11. *Y. brevifolia* p. 119

SECT. I. SARCOCARPA

Yucca § 1. **Eu-Yucca** ***Sarcocarpa** Engelmann in S. Watson, Botany, King Report, 496 (1871); reprinted in Trelease & Gray, Bot. Works G. Engelmann, 276 (1887). — Baker in Gard. Chron. 1871: 1516.

Yucca I. *Euyucca* A. *Sarcoyucca* Engelmann in Trans. Acad. Sci. St. Louis, 3: 34 (1873); reprinted in Trelease & Gray, Bot. Works G. Engelmann, 287 (1887). — Baker in Jour. Linn. Soc. Bot. 18: 220 (Syn. Aloin. Yuccoideae) (1880). — Ricasoli in Bull. Soc. Tosc. Ort. 6: 246 (1881).

Yucca subgen. *Euyucca* sect. *Sarcoyucca* Engelm. ex Engler & Prantl, Nat. Pflanzenfam. II, 5: 71 (1888).

Yucca § *Sarcoyucca* (Engelm). Trelease in Rep. Missouri Bot. Gard. 13: 88 (1902). — Molon, Yucche, 11 (1914).

Yucca sect. III. *Sarcoyucca* (Trel.) Krause in Engler & Prantl, Nat. Pflanzenfam. ed. 2, 15^a: 353 (1930).

SERIES 1. FAXONIANAE, SER. NOV.

Pistillum 4.5–7 cm. longum; segmenta perianthii in tubum basi cylindricum. 12–2.5 cm. longum coalita.

Samuela Trelease in Rep. Missouri Bot. Gard. 13: 116 (1902). — Britton & Shafer, N. Amer. Trees, 149, 159 (1908). — Molon, Yucche, 8 (1914).

The flowers of the two species of this series are distinct from those of other yuccas of the southwestern United States in their pure white color, very sweet and pleasant fragrance and in two structural characters. First, the perianth-segments are united into a long, somewhat obconical or at times nearly tubular base about 1.2–2.5 cm. in length which extends well above the base of the ovary; in this character the flowers are not far removed from those of the *Baccatae* series in which the base (united portion of the perianth) is merely shorter and consequently more cup-shaped. Second, the filaments in the two rows attain the same height; those of the inner row are adnate to slightly above the top of the corolla-tube, those of the outer row just to its top and the free portion of the former is consequently a little shorter than the free portion of the latter; each filament is independently inserted and easily pulled off in its entirety, the attachment not appearing to extend to the base of the corolla-tube; those of the inner row are joined to the petal only and come off with a short, neat triangular base, those of the outer row are joined in the center to the sepal, at sides to the adjacent petals and come off with a longer, broader, more frayed and irregular base.

The two species have more points of similarity than of dissimilarity. Both are arborescent, commonly with one stem and extremely large, crowded, symmetrical, nearly hemispherical to occasionally flat-topped heads of leaves. The base of the mature leaf is very broad proportionately to its median length and always much thickened (nearly from margin to margin) below its union with the blade. The blade of the mature leaf is long, straight, narrowed for a few inches above its union with the base, then broadened to the middle or slightly above, thence tapered to the short-acuminate or acute apex; it is thickened and rigid to about the middle, where narrowed plano-convex, where broadened thinner, flexible, concavo-convex; it is smooth on both surfaces, blue- or yellow-green; short, slender fibres (decurving near point of detachment but pointing forward near their tips) are conspicuous along the upper margins of young leaves but eventually separate for their entire length (the margins of mature leaves mainly non-filiferous) and are

massed in the heart of the leaf-cluster; they are strong if pulled but readily snapped; the spine is about 1.25 cm. in length, sharp, strong, but breaks off readily at point of attachment. The inflorescences are extremely large, sometimes 2 m. in length overall; the flower-bud just before expansion is pear-shaped, — the corolla-segments, still appressed, bulging above the constricted tube; eventually the segments expand to the top of this tube; the segments of the inner and outer rows are much the same length, more or less thickened, brittle and concave in the center for their entire length with a thickened to hood-shaped, fleshy-pubescent apex, thinner (even translucent), and flattish along the margins, throughout waxen, glossy; those of the inner row are slightly broader than those of the outer row with uneven to irregularly denticulate (rather than entire) margins; the filaments are long, slender, sturdy; their lower major portion is thin, somewhat flattened, covered with a short, fleshy pubescence, their short, slightly swollen, clavate tip pubescent or papillose and at anthesis erect-ascending to nearly horizontal, in length $\frac{1}{3}$ – $\frac{1}{4}$ of the whole filament; the anthers are sagittate to hastate; the pistil is long, slender; the ovary is long, commonly fusiform or more rarely tapered, with 6 sharply cleft fissures and 6 round-backed intervening lobes; the style is short, slender, with parallel sides; the 3 stigmas are short, thickish, deeply cleft, erect or slightly spreading at anthesis; the pedicels are terete, a little enlarged near their union with the flower. The writer has seen little mature fruit and none in fresh condition; dried specimens and immature fruits were, in both species, fusiform.

Yucca Faxoniana is a slightly taller plant than *Y. carnerosana*, with a trifle longer, stouter stem; its leaves seem to be more tenaciously attached to the stem and their base perhaps averages broader proportionately to the median length, — this breadth may have a distinct bearing upon tenacity. The two species differ greatly in form of inflorescence. That of *Y. Faxoniana* averages 1.0–1.5 m. but may attain 2 m. in length overall (the scape 30–60 cm. in length); at first it is rather slender, tapered below and above but, with the spreading of the branchlets, becomes eventually broadest at the base with an acute apex; it is densely crowded with flowers; the flowering portion does not surpass the foliage except for part of its length; the branchlets are many, 35–40 or more in number. The inflorescence of *Y. carnerosana* averages about 1.5–2 m. in length overall (the scape 0.75–1.0 m. in length); it is, especially from a distance, ball-shaped, or occasionally, with the spreading of the branchlets, somewhat cubic; it is rather open in effect even when the flowers are expanded; the flowering portion is raised about a foot above the leaves and has few branchlets, 20–25 in number. The bracts, especially those on the scape and at the base of the lower branchlets, seem to differ slightly in size and form in the two species but they also vary greatly within each; in both species those on the scape are attached thereto in a long, more or less triangular tip rather than straight or in a shallow curve as in most species. In *Y. Faxoniana* those bracts just above the leaf-like ones at the base of the scape seem to be abruptly narrowed above insertion, then abruptly broadened to about the middle, the lower bract-like portion about equal to the upper leaf-like portion; those on the upper part of the scape and at the base of the lower branchlets are broad-triangular, 12.75–15.25 cm. in length, 4.5–7.0 cm. in breadth at insertion. In *Y. carnerosana* those just above the leaf-like ones at the base of the scape seem to be gradually narrowed above insertion, then gradually broadened to well above the middle, the lower bract-like portion about twice as long as the upper leaf-like portion; those on the upper part of the scape and at the base of the lower branchlets are narrow-triangular to nearly oblong, 20.25–25.5 cm. in length, 5–7.5 cm. in breadth at insertion. The flowers of *Y. carnerosana* average slightly larger than those of *Y. Faxoniana* and have a little longer, more constricted corolla-tube; the corolla-segments of the outer row about

touch at the top of this tube in *Y. carnerosana* but are separated by 1.6–3.2 mm. in *Y. Faxoniana*. Form of inflorescence clearly differentiates these two species, but form and length of corolla-tube (since somewhat variable in each species) may be a less reliable character. Neither species should be confused with any other *Yucca* growing in the United States.

There is no record of *Y. Faxoniana* from Mexico but its presence there is probable; Standley (Contrib. U.S. Nat. Herb. **23**: 89. 1920) stated: "... doubtless extending into Chihuahua." The center of distribution of *Y. carnerosana* would seem to be in Mexico. In the United States the two species are confined to the Big Bend of Texas and do not extend any great distance north of the Rio Grande; *Y. Faxoniana* occurs to the west in this region, *Y. carnerosana* to the east, and their ranges are separated by a considerable territory.

YUCCA FAXONIANA

Yucca Faxoniana (Trelease) Sargent, Man. Trees N. Amer. 121, fig. 106 (1905); ed. 2, 115, fig. 111 (1922).

Yucca australis sensu Trelease in Rep. Missouri Bot. Gard. **4**: 190, tt. 4, 5 (1893), as to Texan plants; **13**: 117 (1902), as a synonym of *Samuela Faxoniana*. — Coulter in Contrib. U. S. Nat. Herb. **2**: 436 (1894), as to Texan plants. Not *Y. australis* (Engelm.) Trelease (1902).

Yucca baccata var. *macrocarpa* sensu Sargent in Gard. & For. **8**: 301 (1895). Not Torrey (1859).

Yucca macrocarpa sensu Sargent in Gard. & For. **8**: fig. 42 (p. 305) (1895); **9**: 104 (1896), excluding synonymy; Silva N. Amer. **10**: 13, t. 499 (1896), as to plate and as to specific description in large part; Man. Trees N. Amer. 121 (1905), as a synonym of *Y. Faxoniana*. Not *Y. macrocarpa* Engelm., nor *Y. macrocarpa* (Torr.) Merriam.

Samuela Faxoniana Trelease in Rep. Missouri Bot. Gard. **13**: 117, tt. 73, 74, 75, 82, fig. 2, 85, fig. 11, 98, fig. 2 (range map) (1902).

Plant averaging about 4.5 m. in height, in Texas attaining approximately 6 m., commonly with one stem branched once or twice near top, occasionally with several stems of unequal length. Stem 3.5–4.5 m. in height, except rarely covered to ground with dead, closely and neatly reflexed leaves, with leaves 2–2.5 m. in circumference, without leaves 1–2 m., very fibrous, difficult to cut; bark (even on old specimens) rarely uncovered. Head of leaves 0.5–1.15 m. in height, 1.5–2.5 m. in breadth near base, occasionally 2 m. in height, 3 m. in breadth. Base of mature leaf tenaciously attached, about twice as broad as long, its median length 5–7.5 cm., its breadth at insertion 11.5–often 17.5 cm., at union with blade 2.5–6.5 cm. Blade of mature leaf 0.75–1.0 m. in length, contracted (to 2.5 cm. or less in width) for a few inches above union with base, then abruptly broadened to middle or slightly above, thence tapered to apex, greatest width (flattened) 6.5–9.0 cm., across concavity 4.0–6.5 cm.; spine 1.25–2.50 cm. in length. Inflorescence averaging 1.0–1.3 m., occasionally 2 m., in length overall (scape 0.3–0.6 m. in length, 7.5–9.0 cm. in diameter at base); inflorescence proper at first narrowed above and below, at length broadest below with acute apex, exceeding foliage by $\frac{1}{3}$ – $\frac{1}{2}$ its length, densely crowded, glabrous; branchlets about 35–40 or more in number (basal 20.5 cm. in length, central 45.5 cm., uppermost 30 cm. or less), at first erect-ascending, eventually spreading; pedicels 1.2–4.0 cm. in length; bracts on scape few, tenacious; those just above basal leaf-like ones 28–30.5 cm. in length, 4.0–5.0 cm. in breadth at insertion, with upper half leaf-like, with lower half considerably and abruptly constricted near middle, thick, leathery along center with broad, thin papery sides, attached to scape in a long, tenacious tip; uppermost bracts on scape 12–15 cm. in length, 4.5–7 cm. in breadth at insertion, broad-triangular, with short-acuminate to acute, spinescent apex, at first thick, leathery throughout, soon dry, brittle; bracts at base of lower branchlets similar to those on upper part of scape, those at base of central and upper branchlets becoming gradually smaller in all

proportions and thinner throughout; bracts at base of pedicels similar in form to those at base of branchlets, 5.0–7.5 cm. or less in length, 1.2–2.5 cm. in breadth at insertion, much smaller at pedicels at tip of branchlet, extremely thin, at anthesis strong rather than fragile, rather persistent. Flowers 5.75–8.25 cm. in length; base of flower (united portion of perianth) averaging 1.2 cm. in length (frequently less, rarely more), with segments of outer row separated from each other at point where they become free by 1.6–3.2 mm.; anthers 4.5 mm. in length; pistil 4.5–5.75 cm. in length; ovary about $4\frac{1}{2}$ –5 times as long as broad, about 0.7 cm. in diameter at anthesis, commonly fusiform, at times tapered from base to apex, often lop-sided; style about 4.5 mm. in length, 3.2 mm. in diameter; stigmatic opening wide above. Fruit (dried specimens) slightly tapered above and below, about 7.5 cm. in length, 2.5 cm. in diameter near middle, contracted for 2.5 cm. below tip into slender beak (enlarged style and stigmas), for short distance above base covered by still united, enlarged perianth-tube; in some young fruits the beak occasionally twisted, screw-wise.

Range. In Texas extending from the mountainous regions along the Rio Grande, where Presidio, Jeff Davis, Culberson and Hudspeth Cos. adjoin, as far north and northwest as the vicinity of Van Horn on the east and Sierra Blanca on the west.



MAP 1. Ranges of *YUCCA FAXONIANA* (o)¹ and *YUCCA carnerosana* (●).

TEXAS. Culberson Co.: Mountains north of Van Horn, grows as a stout tree 3–4.5 m. high, Aug. 23, 1902, *V. Bailey* 502 (W). — Van Horn, sandy plains and rocky bluffs, June 10, 1905, *J. Reverchon* 2903 [? = 2963] (M). Hudspeth Co.: Nine miles west of Van Horn, on north side of road leading to Sierra Blanca, April 16, 1932, *McKelvey* 2653 (AA). — Near Eagle Flat east of Sierra Blanca, April 15, 1932, *McKelvey* 2650 (AA). — Sierra Blanca, May, 1892, *W. Trelease* (2 sheets; M); Aug. 11, 1900, *W. Trelease* 413 (M); Aug. 11, 1900, *W. Trelease* (M); April 7, 1902, *W. Trelease* (AA) (3 sheets; M). —

¹ The type locality is indicated by an encircled symbol.

Sierra Blanca, Sept., 1894, *C. S. Sargent* (2 sheets; AA). — "Flowered at Amer. Mus. Nat. Hist. New York, from a log sent from Sierra Blanca, Texas," (AA: **type**). — Sierra Blanca, May, 1900, *Gilcrease* (M). — Sierra Blanca, April 5, 1918, *E. O. Wootton* (W). — Vicinity of Sierra Blanca, Feb. 24, 1910, *J. N. Rose*, *P. C. Standley* and *J. G. Russell* 12221, 12227 (W). — Vicinity of Sierra Blanca, Oct. 15, 1913, *J. N. Rose* and *W. R. Fitch* 17931 (W). — Sierra Blanca, April 11, 1930, *M. E. Jones* 25919 (M) (PO 178280, 178281, as to leaf only). — Indian Hot Springs, April 30, 1930, *M. E. Jones* 25970 (M; in part) (PO; in part). — Indian Hot Springs road, not far south of Sierra Blanca, April 27, 1931, *McKelvey* 2053 (photo 103-12), 2054 (photo, 103-4) (AA); April 15, 1932, *McKelvey* 2648 (AA). — Cultivated at Sierra Blanca railroad station, March 25, 1932, *McKelvey* 2562A (AA).

In 1893 Dr. Trelease referred to *Yucca australis* (Engelm.) Trel. four different *Yucca* collections: (1) material from Sierra Blanca, Texas; (2) *Coulter* 1571 from Mexico; (3) *Thurber* 1857 [=857] from Parras, Coahuila, Mexico; and (4) *Pringle* 2841, 3912 from the Carneros Pass, also in Coahuila. In 1902, after further study, he referred only the Thurber material to *Y. australis*; for the Sierra Blanca plant he proposed the new name *Samuela Faxoniana* and with it associated part of the Coulter material noting that the name *Samuela* "is dedicated to my little son, Sam Farlow Trelease, who in the springs of 1900 and 1902 accompanied and materially aided me in a field study of both species of this genus . . ." The Pringle specimens he considered to represent a second species in his new genus, — *Samuela carnerosana*.

Most writers since 1902 have accepted Trelease's genus *Samuela*; Sargent, however, in 1905 treated the Sierra Blanca plant as a *Yucca*, although he cited no reasons for so doing. The present writer has followed Sargent; her reasons for non-acceptance of the genus *Samuela* have been given in the introduction.

Writing of *S. Faxoniana* Trelease stated: "In the absence of type material or any collections from the type localities these trees [about Sierra Blanca] have been considered to represent the *Y. baccata macrocarpa* of Torrey and, under the name *Y. macrocarpa* . . . are described and figured . . ." He concluded: "This species, which is well described by Professor Sargent, under the name *Yucca macrocarpa*, I take pleasure in dedicating to Mr. C. E. Faxon, whose excellent figures of it in the *Silva* faithfully represent its technical characters." A specimen in the Arnold Arboretum herbarium is here chosen as type for the following reasons.

In an article on the tree yuccas of the United States, Sargent (1895) wrote of a species growing at Sierra Blanca, Texas. While he believed it identical with certain other arborescent yuccas of southwestern Texas — notably with Torrey's *Y. baccata* var. *macrocarpa* (= *Y. Torreyi* Shafer) since he adopted its varietal name — yet his article in so far as description and illustration is concerned is applicable mainly to the species under discussion. He wrote: "A young tree of this *Yucca* was cut last April at Sierra Blanca and sent to New York to represent the species in the Jesup Collection of North American Woods in the American Museum of Natural History. After its long journey to New York by rail and ocean the rootless plant developed its flower-cluster in the Museum, where it was photographed by Mr. DeL. C. Laudy, of the Museum. A reproduction of this photograph appears on page 305 of this issue . . ." In the Arnold Arboretum herbarium are two sheets. On one is a flowering branchlet noted by Faxon as taken from this plant and roots similarly identified by Sargent; a "Silva of N. America" label indicates that the material was used in the preparation of the plate; there is no date but Sargent's article was published in July, 1895, and we may infer from his text that the flowers were produced in April or May of that year. Because of Trelease's choice of specific name and reference to Sargent's description and Faxon's plate it has seemed logical to select these flowers as type of *Y. Faxoniana* for they represent the most significant of the material available to Trelease and, moreover, were taken from a plant known to have come from

Sierra Blanca and cited and illustrated in Sargent's first description. On the second sheet are two leaves labelled only "*Y. macrocarpa*" by Faxon; while presumably from the same plant the incomplete notation excludes this sheet as a part of the type.

Herbaria records show that, apart from the above, only seed and leaves were collected before Sargent described the species in 1895, Trelease (1892) and Sargent (1894) collecting very similar material. Flowers were subsequently collected by Gilcrease (1900), Trelease (1902), Rose and Fitch (1913) and Jones¹ (1930) who, however, failed to distinguish this species from others in the same region. These flower specimens, and leaves collected by Rose, Standley and Russell (1910) represent all the Sierra Blanca material. *Yucca Faxoniana* grows on the town's southern outskirts but the writer's numbers came from several miles south, towards Indian Hot Springs. Jones (1930) collected flowers at Indian Hot Springs.

V. Bailey (1902) photographed a plant and collected fruit and leaves (no. 502) in the mountains north of Van Horn and there is a Reverchon specimen from Van Horn dated 1905; these are the only records from Culberson Co. The writer's collection from about 9 miles west of Van Horn came probably from Hudspeth Co., the plants extending from this region northeastward into the mountains where Bailey's 502 was gathered; his *Biological Survey of Texas* (N. Amer. Fauna, no. 25, t.V., fig. 2, 1905) gives a habit photograph of a plant of this group (captioned "Desert Vegetation of Great Bend region"); it might be either our species or *Y. carnerosana*.

Yucca Faxoniana appears but little in the literature and is rarely cultivated except locally. The writer believes that the juvenile plant (growing in the Jardin d'acclimatation at Hyères, France) pictured by Molon (Yucche, 25, fig. 5. 1914) more nearly resembles *Y. baccata* than *Y. Faxoniana*.

Sierra Blanca, the type locality of *Y. Faxoniana*, has been visited several times by the writer. At the end of April, 1931, plants were in fine flower there; along the road south to Indian Hot Springs it was plentiful just outside of Sierra Blanca, then stopped and began again as the low mountains were approached to the east and south, evidently preferring their slopes and mesas to the desert lying west; the elevation at Sierra Blanca is 1350 m. and the plants may extend a few thousand feet higher in the foothills; the soil was rocky and, superficially certainly, extremely dry; creosote-bush was a common associate. The plants grew in great numbers and were easily distinguished from the less numerous *Y. Torreyi* by their pure white inflorescences; their habit of growth and their symmetrical and extremely large heads of leaves also marked them as distinct.

The region was again visited three times in 1932, in late March, mid-April and near the end of May, but bloom was insignificant and no fruit was setting although some, persisting from a previous year, was collected from plants cultivated at the Sierra Blanca railroad station. The few inflorescence-buds found on April 16 were full of a sweet, sticky fluid which dripped out plentifully when the bud was reversed. Handsome trees cultivated in Van Horn flowered in 1932 and drought, where plants grew untended, presumably explained the absence of flowers. That year, specimens were seen which had escaped attention before; along the new road from Van Horn to El Paso the first grew some 9 miles west of Van Horn, before reaching Allamore, the elevation about 1200 m.; here *Y. Torreyi* was the common species but *Y. Faxoniana* was scattered with it on the flats north and south of the Southern Pacific Railroad and extended into the foothills to the north; it was plentiful just west of Eagle Flat where it was mixed with both *Y. Torreyi*

¹ M. E. Jones collections may be perplexing: his no. 25919 (PO 178281) bears a leaf of *Y. Faxoniana* but flowers of *Y. baccata*; his no. 25970 (PO 178181) (M 995274) is in part *Y. Faxoniana*, in part *Y. Torreyi*; also we find flowers of *Y. Faxoniana* included with material (here referred to *Y. Thornberi* McKelvey) from the Chiricahua Mts., Arizona; see Jones 25918 (PO 178408) and 25917 (PO 178409).

and *Y. elata*; not many miles east of Sierra Blanca both *Y. Torreyi* and *Y. Faxoniana* stopped abruptly and *Y. elata* grew in a pure stand; westward for about 8 miles beyond Sierra Blanca our species could be seen along the foothills of the mountains to the south, but further west the valley widens and the road runs through a desert producing mainly creosote and mesquite.

V. L. Cory (Bull. 33, W. Texas Hist. Sci. Soc. Publ. no. 3, 34, 1930) wrote of the distribution of the species in Texas: "*S. Faxoniana* is found between the Tierra Vieja Mountains and the Van Horn Mountains, between the Van Horn Mountains and Eagle Mountain, between Eagle Mountain and the Quitman Mountains, and, excepting the Tierra Vieja, around the northern bases of the above mountains and to within five to twenty-five miles of the Rio Grande on the south, and also on its northern extension on gravelly hills and ridges as far as eighteen miles north of Allamore . . ." Mr. Cory kindly outlined this area on a map and wrote (in litt. March 9, 1934): ". . . it is shown that it occurs in the Counties of Presidio, Jeff Davis, Culberson and Hudspeth."

Trelease refers to large trees planted at the stations of the Southern Pacific Railroad. Unfortunately one handsome group, it is believed at Eagle Flat, lay upon the ground in 1932. Outside of Van Horn small plants had been set out and most were doing well; an occasional *Y. Torreyi* grew in this avenue, probably planted by mistake; this was one of the few attempts to beautify a great highway which was seen in western Texas. Quite a number of the plants growing along the road to Indian Hot Springs had been burned in 1932, apparently maliciously, for nothing else in the neighborhood had been injured; the species is of limited occurrence in this country and should be preserved. But the farmer's very common aversion to yuccas was expressed by a property owner at Cedar Hill, near Dallas. It was the author's first attempt to collect yuccas and knowing that certain ones grew within his fenced fields she sought him out with considerable effort and asked deprecatingly whether he would object if she took, *with great care*, some of the flowers and leaves. His reply was "I'd be thankful if you took them all, especially roots."

Dr. Trelease in 1893 wrote of *Y. Faxoniana*; "Seedling plants have the blue-green leaves of *Treculeana*, and possess a cluster of rather fleshy fusiform roots becoming as thick as one's finger, but no central tap root. With age these roots are replaced by long, tough, cord-like roots as thick as a lead pencil. The trunks at length become a foot or two thick, and generally from ten to fifteen feet high, where my observations were made . . . In the Texan region indicated [Sierra Blanca], this form grows with *Yucca elata*, *baccata* being absent¹; but it blooms a full month earlier than the associated species. Its fruit . . . is usually long beaked, and the seeds are tunneled in the manner characteristic of the work of the *Pronuba*, the pulp being perforated by the escaped larvæ. I was unable to study this species in bloom, but large fruits gathered some three weeks after fertilization show none of the constrictions or indentations which so commonly mark the ovipositing punctures of the *Pronuba* moths, which led to a suspicion that the eggs may be deposited in the upper part near the stigma." Later, in 1902, Trelease wrote: "The long perianth tube of *Samuela* . . . is so closely applied about the lower part of the ovary, as, apparently, to make it impossible for any insect to reach the bottom of the latter, with even a very slender tongue. Though the actual pollination of this genus is yet to be observed, it is effected by *Pronuba yuccasella*, at least in *S. Faxoniana*, in the flowers of which pollen-laden females of the moth were discovered by my son and myself in April, 1902, and the only explanation of the highly specialized tubular perianth I can suggest is that, restricting the access of the ovipositing moths to the upper half or two-thirds of the

¹ Nor has the author seen *Y. baccata* at Sierra Blanca. Some M. E. Jones sheets (although the collector seems to have been unaware of the fact) possibly record it from that region.

ovary, it may limit the number of eggs that they can lay in a given pistil, to the advantage of the plant."

A sheet (M 140095) bears notes made by Trelease at Sierra Blanca; the beginning is dated 7/13/92, the end 5/29/92. It may be of interest to quote these in part: "Yucca, 'smooth baccata,' was in full bloom here May 8, the last flowers apparently over not above a week ago, some fruits already 4 in. long, but no larvae seen in those cut open, — hence long incubation. The fruits at first point indifferently, but all of these larger ones are pendent. Very few show any marked irregularity, and the deformities seen are not connected with any evident *Pronuba* puncture. All sutures have disappeared on these larger ones. The surface of all is marked by numerous punctures (*Prodoxus* ?) which are rather deep in the pulp. From what I can see I believe that oviposition occurs on the style, as in *brevifolia*, and the fruit is commonly long beaked (acuminate). Blooming a month before *elata* right here, and with this indication, this species is probably pollinated by its own distinct *Pronuba*, all of the latter seen in *elata* flowers being freshly excluded. The trunks are sometimes a foot thick and 10–15 ft. high, sometimes with double crown. The base of trunk is not expanded as in *brevifolia*, but the base of overturned trunks show the same sort of long roots as thick as a pencil. Young plants have a cluster of thick fusiform rather fleshy roots as thick as one's finger, but no central tap root. The species is not infrequently spread by suckers at base when the main trunk is hurt, — but not at all caespitose. The old leaf margin at first has many whitish fibers, about an inch long and the same apart, that are quite regularly pectinately recurved; later they peel off, leaving the purplish margin nearly or quite destitute of fibres." There are further notes and a sketch made at Eagle Flat, May 31, 1892, but the author is uncertain whether they refer to *Y. Faxoniana* or to *Y. Torreyi*; with these (M 140095) is a misplaced photograph of *Y. carnerosana*.

Sudworth (Miscel. Circ. 92, U. S. Dept. Agric. 48, 1927) who, like Sargent, classified the Sierra Blanca plant as a *Yucca*, not as a *Samuela*, cites the common names Spanish-dagger (Texas), Sierra Blanca yucca, Faxon yucca, Spanish bayonet; in a footnote he writes: "... Britton and Shafer [N. Amer. Trees, 159, fig. 119, 1908] ... have followed Dr. Trelease in maintaining the name [*Samuela*], the common name given to it being Sierra Blanca *Yucca*," italics mine.

On April 16, 1932, the writer made several collections of flowers about 9 miles west of Van Horn, in Hudspeth (?) Co. One, *McKelvey* 2655–4 appears to have come from a plant of hybrid origin, the parents *Y. Faxoniana* and *Y. Torreyi*; it is not included in the citation of specimens. *Y. Torreyi* is the common species here but *Y. Faxoniana* is also present in smaller numbers and both bloom at the same season. Far back from the road a plant was in bloom which because of its habit and pure white inflorescence was believed to be *Y. Faxoniana*; since flowering was rare on that species in 1932 it was sought out. The flowers proved surprising. They were small and globose, except in their whiteness similar in general appearance to those of the small-flowered form of *Y. Torreyi* here distinguished; they were variously distorted and unstable, for example the upper part of the pistil frequently twisted screw-wise, — a characteristic not uncommon in one capsular species but only rarely noted in any of the yuccas with baccate fruit; the base of the flower, gibbose in *Y. Torreyi*, short-tubular in *Y. Faxoniana*, was in some flowers gibbose, in others short-cup-shaped, again both forms of base were present in one flower; the short slender style with parallel sides and the erect, slightly thickened stigmas were similar in form to those of *Y. Faxoniana* but the short, frequently lop-sided and at times distorted ovary bore a distinct resemblance to the tapered one of *Y. Torreyi* and none, either in size or in form to that of *Y. Faxoniana*. Most convincing of all, occasional filaments in a flower were attached as in the Faxonianae series, the rest as in *Y. Torreyi*. Taking into account the

plant habit and the whiteness of the flowers our species, not *Y. Torreyi*, was presumably the dominating influence.

YUCCA CARNEROSANA

***Yucca carnerosana* (Trelease), comb. nov.**

Yucca australis sensu Trelease in Rep. Missouri Bot. Gard. **4**: 190 (1893), as to Pringle specimens. Not *Y. australis* (Engelm.) Trelease (1902).

Samuela Carnerosana Trelease in Rep. Missouri Bot. Gard. **13**: 118, frontispiece, tt. 76, 78, 79, 80, fig. 1, 81, 85, fig. 12, 87, fig. 2, 98, fig. 2. (range map) (1902).

Plant 2.5–3 or 3.5 m. in height (but said to attain a larger size in certain parts of its Texas range), commonly with one undivided stem and head of leaves, occasionally branched once or twice at 1.5 or 2 m. from ground, rarely with several stems of unequal length. Stem 2–2.5 m. in height, commonly covered to the base with dead, reflexed leaves, without leaves 1.15–1.30 m. in circumference at 0.5 m. above ground and 1.5–2 m. immediately at ground; bark fine, close, broken by narrow, shallow, vertical and horizontal fissures into flat plates 0.3–0.6 m. square or slightly longer than broad, pale gray tinged with reddish brown, on extremely old plants slightly coarser, rougher. Head of leaves 1–1.30 m. in height, 2–2.5 m. in breadth near base. Base of mature leaf easily separated from stem, about twice as broad as long, its median length 5–9 cm., its breadth at insertion 12–15 cm., at union with blade 2.5–4 cm. Blade of mature leaf 0.55–1.15 m. in length, averaging 0.75 m., contracted for a few inches above union with base, then broadened to near middle, thence tapered to apex, greatest width (flattened) 7–7.5 cm., across concavity 5–6.5 cm.; spine about 1.2 cm. in length. Inflorescence 1.5–2 m. in length overall (scape 0.75–1 m. or even more in length, 7.5–10 cm. in diameter at base); inflorescence proper nearly spherical, occasionally slightly cubic, exceeding foliage by about 0.3 m., rather open, not infrequently tinged (bracts, rhachis, corolla) with rose or lilac, glabrous; branchlets about 20–30 in number (basal 15–17.50 cm. in length, central 0.5–0.61 m., uppermost much reduced), erect-ascending; pedicels 2 cm. or more in length; bracts on scape few, tenacious; those just above basal leaf-like ones 25–30 cm. in length, 5–6.5 cm. in breadth at upper point of attachment, with upper third leaf-like, with lower two-thirds slightly and gradually constricted from base to near middle (where 2–2.5 cm. in width), leathery along center with thinner sides, attached to scape in a long, tenacious tip; uppermost bracts on scape 20–25 cm. in length, 5–7.5 cm. in breadth at insertion, narrow-triangular to nearly oblong, with short-acuminate to acute, spinescent apex, at first thick, leathery, soon dry, brittle; bracts at base of lower branchlets similar to those on upper part of scape, those at base of central and uppermost branchlets becoming gradually smaller in all proportions and thinner throughout; bracts at base of pedicels similar in form to those at base of branchlets, 2.5–5 cm. in length, 1.2–2.5 cm. in breadth at insertion, much smaller at pedicels at tip of branchlet, extremely thin, persistent, striate, roughish. Flowers 6.5–9.5 cm. in length; base of flower (united portion of perianth) 1.2–2 cm. – rarely 2.5 cm. in length, with segments of outer row nearly touching at point where they become free; anthers 5–7 mm. in length; pistil 5.75–7 cm. in length; ovary about 5 times as long as broad, 7–12 mm. in diameter, commonly fusiform, symmetrical; style about 7 mm. in length, 3 mm. diameter; stigmatic opening large or small above. Fruit (of type specimen) 10 cm. in length, 4 cm. in breadth near middle, slightly narrowed above and below, extreme tip and old floral base lacking.

Range. Confined to Brewster Co., Texas, where it extends from the mountainous regions about Boquillas on the Rio Grande northward to slightly beyond Persimmon Gap in the Santiago Mts.

For range map see p. 19.

MEXICO. Zacatecas: Hacienda de Cedros . . . Zacatecas (norte), hills and foothills, "Palma samandoca," March 29, 1908, *F. E. Lloyd* 35 (W) (M) (UC); Mazapil, 1908, *Lloyd* 35 (M). — Northern

Zacatecas, Nov. 1907, *F. E. Lloyd* (2 sheets; W). Coahuila: At Saltillo . . . and vicinity, 1898, *E. Palmer* 197 (M). — Boca del San Lorenzo Cañon, near Saltillo. Leaves of cogollo or bud used for production of palma ixtle fiber, May 20, 1903, *L. H. Dewey* 578 (M) (W). — Limestone hills, Carneros Pass, May 11, 1891, *C. G. Pringle* 3912 (M 135656, 135657, 140116 fragments only; type) (AA) (P) (W) (UC). — Carneros Pass, April 25, 1900, *W. Trelease* 167 (9 sheets; M); Carneros Pass, April 25, 1900, *W. Trelease* (M); Carneros, March 23, 1905, *W. Trelease* 58 (M).

TEXAS. Brewster Co.: South of Persimmon Gap on road from Marathon to Boquillas, April 24, 1931, *McKelvey* 1959 (photo. 99-8), 1960 (photos. 99-10, 100-2), 1961 (photo. 100-6) (AA). — North of Persimmon Gap, April 24, 1931, *McKelvey* 1983 (AA). — East base of Chisos Mts., May 26, 1901, *V. Bailey* 462 (photo.; W; to be associated with specimen W 411192 not located). — Nail place, Chisos Mts., August 22, 1915, *M. S. Young* (UT).

Yucca carnerosana was first described by Dr. Trelease in 1902, from collections (nos. 2841, 3912) made by C. G. Pringle in 1891 at Carneros Pass, Coahuila, Mexico, — the locality recorded in the specific name. Trelease made no direct reference to his own collections made in 1900. *Pringle* 2841 has not been located. *Pringle* 3912 is found in five herbaria; three sheets are in the Missouri Botanical Garden (M 135656, 135657, 140116, — the last fragmentary). Since Trelease must have studied this collection, since it represents ample material (foliage, fruit, seed) and since he specified that the Pringle collections represented his new species, these sheets are chosen as type; the type locality is the Carneros Pass. Trelease noted: "The very thick fibres of the leaves distributed by Mr. Pringle are exceptional;" while unfortunate that the type should represent unusual material Trelease's designation calls for its choice.

The writer has not studied *Yucca* in Mexico and does not feel qualified to determine incomplete herbarium material from that country. Foliage alone, even when familiar with the plant in the field, is often confusing; but she knows of no Mexican species with flowers similar to those of the Faxonianae series; her citation of Mexican specimens of *Y. carnerosana* includes only such as represent flowers or which are substantiated by photographs. Dr. Trelease has studied these plants in Mexico as well as the larger part of the herbarium material from that country and his determinations should stand until a field study indicates that modification of his findings is necessary.

Trelease wrote that *Y. carnerosana* "from near the city of Saltillo extends southward, on the mountain slopes and in the higher valleys, to some distance below the Tropic of Cancer, and is especially abundant in the higher valleys about Carneros pass, where the Mexican National railroad crosses the mountains south of Saltillo, and about Las Tablas on the Tampico branch of the Mexican Central." Material from near Carneros consists, in addition to Pringle's, of excellent collections made by Trelease in 1900 and in 1905, — eleven sheets in the Missouri Botanical Garden. In 1905 he procured two interesting photographs at Carneros, one (M 140110) showing the method of cleaning the fiber, another (M 140111) showing "huts made of its trunks and thatched with its leaves, and 2 cart loads of its cleaned fiber." Of the uses of this plant he wrote in his monograph: "The trunks of . . . *Samuela* are occasionally used for palisade construction, and in the Carneros pass I have seen houses built almost entirely of material obtained from *S. Carnerosana*, — the walls of palisade-like trunks set on end, and the roof thatched with the leaves."

The only other specimens from Coahuila are *Palmer* 197 and *Dewey* 578 (later mentioned), both from the Saltillo region.

From the province of Zacatecas are two sheets, both *F. E. Lloyd* 35, March 29, 1908. One (M 140126) is from the Hacienda de Cedros, northern Zacatecas, the other (M 140125) from Mazapil. The first is interesting because of the pubescent character of the inflorescence fragments, all other specimens of *Y. carnerosana* seen by the writer being glabrous; this *Lloyd* 35 is also in the U.S. National Herbarium and at the University of

California. The second bears two envelopes; in one are six photographs all labelled *Lloyd 35*, "Palma samandoca;" some show the characteristic ball-shaped inflorescence; in the other are photographs taken by Kirkwood at Cedros in 1908; they show "Palma zamandoca" growing in vast numbers on mountain slopes, the elevation in one instance noted as 2100 m.; a note in Trelease's hand reads: "Palma zamandoca (= Lloyd's Palma fina [?] or Palma real) *Samuela carnerosana*." The inflorescence is well shown in another unnumbered Lloyd (?) photograph (M 140121) dated March 29, 1908; here the inflorescence has been cut from the plant and for comparison rests against the trunk; still other Lloyd collections are at Washington. One excellent photograph appears twice, once (M 140122) with the *S. carnerosana*, again (M 140095), misplaced, with the *S. Faxoniana* collections.

Trelease noted *Y. carnerosana* as extending from the Carneros Pass to about Catorce and Cardenas, the latter in southern San Luis Potosi province; the only record from this general region, considerably south of Carneros, is a photograph taken by L. H. Dewey (M 140123) in the mountains of Hacienda Dominguez east of Cerritos, May 26, 1903; to the writer the determination appears questionable. The only Dewey specimen is his 578 (M 716828, 516790), foliage, from Boca del San Lorenzo Canyon, near Saltillo, Mexico; it refers to the plant as "Palma samandoca" and a note states, "Leaves of cogollo or bud used for production of palma ixtle fiber . . ."

In the *U. S. Dept. of Agriculture Yearbook for 1903* (p. 398, t. 49, fig. 2. 1904) is an article by Dewey, *Principal Commercial Plant Fibers*, with a picture of this species; Dewey wrote: "Palma istle is obtained from the inner leaves of yuccas, known in Mexico as palmas. The species producing most of this fiber is called palma samandoca (*Samuella* [sic] *carnerosana* . . .) This plant has a trunk 6-15 inches in diameter, and attains a height of 6 to 15 feet, bearing at the top a dense cluster of sword-like leaves, 20 to 30 inches long . . ." He discussed in detail the production and uses of Palma ixtle. Endlich, in *Der Ixtle und seine Stammplanzen*, (Tropenpfl. Beih. 9: 248, fig. 2. 1908) illustrated the plant and gave description, range and the uses of its fiber. Flowers and foliage (M 140113, 140115) collected April 22, 1905, at Rancho de la Luz, Coahuila, by Dr. Endlich, of Monterey, Mexico, are from a plant cultivated at Hacienda de la Paila, the plant called Palma de San Pedro and Palma Pita. Another sheet (M 140114) is labelled "no. 1" (as is M 140113) but the locality, Rancho de la Luz, has been erased.

Standley's *Trees and Shrubs of Mexico* (Contrib. U. S. Nat. Herb. 23: 89. 1920) in which Trelease assisted in the preparation of the Liliaceae, describes the uses made of the *Samuela*: "The large trunks are used for fences or for the walls of houses, and sometimes they are split open so that the soft interior may be eaten by stock. The large flower panicles are eaten greedily by cattle and are sometimes gathered for this purpose. The immature inflorescences are used also for human food, boiled or roasted. The leaves yield a fiber (known in Zacatecas as 'palma ixtle' fiber) useful for cordage. The pulpy, sweet but somewhat bitter fruits are eaten by people as well as by wild and domestic animals."

In discussing, in his monograph, the economic uses of the *Yucca* and allied genera Trelease notes: "In Mexico and our southwestern states the fiber of several of the baccate species is crudely cleaned and put to various local uses, cordage included . . . About the Carneros pass, where it is very abundant, *Samuela Carnerosana* is similarly used . . . Notwithstanding their stiff-pointed leaves, the species which grow in the grazing country are attractive to cattle¹ in the flowering season, and the animals often display some dexterity

¹ The author has regretted that she did not photograph a cow which she saw standing upon its hind legs with forefeet just reaching into the leaves of a tall plant of *Y. carnerosana*; its efforts were concentrated upon the flower-cluster still higher in the air. When the yucca or agave enthusiast arrives in an auspicious locality after hundreds of miles of travel only to find that cattle have preceded her, all sympathy for the famished or thirsty condition which induces these animals to combat perilous spines disappears; on this occasion the cow's acrobatic prowess was so very remarkable that she was left undisturbed.

and no little courage in riding down the smaller trees or otherwise getting at their succulent flower-clusters, which are further gathered and carried in to be fed to sheep and other animals in some cases, as, for instance, in the Carneros pass, where I have seen large cart loads of the great panicles of *Samuela Carnerosana* being taken to the hamlet for this purpose. In their early stages, too, the inflorescence of *Yucca*, *Hesperoyucca* and *Samuela* is said to be either boiled or roasted and used for human food or even eaten raw . . . the nearly fiberless trunks of the southern *Samuela* are decorticated or split open so that they can be eaten by stock. As a rule, the fruits of the baccate species of *Yucca* and *Samuela* are promptly eaten by birds, rats, etc., but domesticated animals are said to like them, and, being quite sugary, they are enjoyed by the Indian and Mexican children, who commonly call them figs or dates. All that I have tasted possess, in combination with their sweetness, a characteristic bitterness, which makes them somewhat unpalatable, and those of the Rocky Mountain and Mexican region possess a rather viscid pulp which renders them unpleasant to handle when broken."

V. L. Corey of the Texas Department of Agriculture was the first to publish upon the occurrence of *Y. carnerosana* in the United States. He told (Bull. 33, W. Texas Hist. Sci. Soc. Publ. no. 3, 34. 1930) of studying the distribution of this species and of *Y. Faxoniana* in the Trans-Pecos region of Texas in 1928. *Yucca carnerosana* he recorded only from the north and northeast and the south and southwest of the Sierra del Carmen, an extension southeastward of the Santiago Mts. of Brewster Co. There is a photograph taken by Vernon Bailey (no. 462), May 26, 1901, at the "east base of the Chisos Mts.," Brewster Co.; with it belongs, a note states, the U. S. Nat. Herbarium sheet 411192 but this has not been located. The photograph was determined by Trelease as *Y. Faxoniana* but Bailey added that it was instead *Y. carnerosana*, and with this the writer agrees. This photograph, and the specimen undoubtedly, would seem to represent the first record of *Y. carnerosana* in the United States. In the University of Texas herbarium is another specimen (leaves only) also from the Chisos Mts.

In 1931 the writer visited a part of the plant's range, traveling from Marathon to near Boquillas. The first specimens seen were in the desert 30 miles north of Persimmon Gap in the Santiago Mts.; they extended southward to the Gap but were few and widely scattered; after passing the Gap they stopped for a time but began again in the desert about eight miles south. Here *Y. Torreyi* predominated but at a considerable distance *Y. carnerosana* could be seen in great numbers on the foothills and low mesas of the Carmen Mts. to the east and southeast, its ball-shaped inflorescences recognizable from afar. At Dagger Flat, not far into these mountains, the plants are said to be very numerous and of greater size than elsewhere in the vicinity. This region was visited again in 1932, in March and in late April, but *Y. carnerosana* did not flower, presumably because of the severe drought; the hills were scanned with field-glasses but not an inflorescence could be detected; in 1931, when the season was wet and late, they could be seen from afar with the naked eye.

Yucca carnerosana and *Y. Torreyi*, even from a distance, are not to be confused when mingled in the field. The inflorescence of the former is handsome and conspicuous, pure white, ball-shaped, raised some distance above the leaves; that of the latter, in its small-flowered form especially, in juxtaposition appears somewhat greenish, even sordid, is narrowed above and below or slightly broadest near the top and is set down among the leaves for a part of its length. *Yucca carnerosana* is, moreover, a strikingly symmetrical plant with nearly hemispherical heads of broad, handsome leaves; *Y. Torreyi* is rather untidy in appearance, the heads of leaves elongated, the leaves themselves coarse and rough in effect. Mr. Cory noted of *Samuela*: "It differs from its nearest counterpart in the yuccas,

Y. macrocarpa, in having a noticeably rounder head, a greater number, usually, of spreading leaves (and these are relatively broader in proportion to their length), and a difference in the color of the leaves — those of the *Samuela* being a crab-apple green, and those of the yucca a yellowish-green."

Yucca carnerosana appears to prefer the foothills, the scattered specimens in the desert being merely outposts; *Y. Torreyi* on the other hand is most plentiful on the desert and ascends the mountain slopes in diminishing numbers. The altitude at Persimmon Gap is 900 m., but southward the country becomes lower; ocatillo and the creosote-bush abound. This region of the Big Bend seems to offer a route of plant entrance from Mexico into the United States, for, to the south of where *Y. carnerosana* was seen, *Y. rostrata* also occurs, not far from the Rio Grande; this plant in general aspect may easily be mistaken for the also present *Y. elata*, but its leaf-margins are corneous and for the most part denticulate and its fruit is entirely distinct. Unfortunately in 1932 it had failed to flower by the month of May; while drought may have accounted for this it is possible that its season of bloom may be even later.

For a possible hybrid between *Y. carnerosana* and *Y. Torreyi*, see *Y. Torreyi*.

Molon (Yucche, 25, fig. 4. 1914) refers to this species, which he treats as a *Samuela*, as cultivated in several Italian botanical gardens.

SERIES 2. BACCATAE, SER. NOV.

Pistillum 4.5–8.25 longum; segmenta perianthii in tubum 0.7–1.3 cm. basi obconicum vel cupularem coalita.

No species of this series is arborescent. All are caespitose with few or many, short to rather long stems which are either procumbent or more or less erect.

Their flowers are distinguished by two structural characters. First, the perianth-segments are united just above the pedicel into a cup-shaped or short-obconical base 7–12 mm. in length which is frequently more or less stipitate below; this base extends slightly or considerably above the lower portion of the ovary; in this character the Baccatae series closely approach the Faxonianae series in which the flower-base is merely more elongated and consequently extends higher about the ovary. Second, all filaments in any one flower are approximately the same length and are attached to the same height on the corolla-segments; their free, upper portion, therefore, is of equal length in the two series; their lower, adnate portion is united in a collar-like band 3.2–12 mm. in depth which extends from below to above the base of the ovary; while apparent in the flower this band is more conspicuous in the fruit for it is then thickened and enlarged and, although for a time hidden beneath the unreflexed perianth, is eventually exposed to view when both corolla and filaments have become reflexed.¹ In the series Treculeanae (often in *Y. schidi-gera* and *Y. Schottii*, only occasionally in *Y. Torreyi* and *Y. Treculeana*) the filaments (frequently much broadened at base) unite into an extremely narrow, uneven band; this united portion scarcely extends, if at all, above the base of the ovary and is so shallow as to be scarcely distinguishable in the flower although it may be slightly more apparent in the fruit.

Within the group the four species are mainly distinguished by differences in plant habit, in form of leaf-cluster and in form and position (in relation to the foliage) of the inflorescence; to a lesser degree (since the foliage of all baccate yuccas is somewhat similar and also in any one species very variable) the leaves of each are distinct.

In all species of the series the flowers vary considerably in size and, less often, in form on different plants; while, occasionally only, small and globose, they are commonly extremely large and campanulate; constriction of the corolla just above the cup-shaped base — producing a pear-shaped flower — is not unusual, it seems to be least common in *Y. Thornberi*. The filaments in *Y. arizonica* and *Y. Thornberi* are long, slender, flaccid rather than sturdy, and the club-shaped tip is ill-defined, since scarcely broader or more swollen than the lower portion and at anthesis not turned at a pronounced angle to it, and is very short in proportion to the whole; in *Y. baccata* and *Y. confinis* the filaments are more virile and the club-shaped tip is longer, stouter and turned at a pronounced angle at anthesis; the fleshy pubescence, present on the filaments of all, is probably longer and more plentiful on the first two species mentioned than on the last two. The anthers in all vary in form, being oblong, hastate, or sagittate. The pistil is large, with long, upward-tapering ovary and short, for its length stoutish, obscurely three-lobed, parallel-sided style which is about as long as or a little longer than broad and terminates at base in 3 short, ill-defined tips and at apex in 3 erect, fleshy stigmas which only exceptionally spread and exceed it in diameter; at anthesis each stigma is cleft at apex and, looked at from above, more or less heart-shaped. Eventually the fruit in all is conical or occasionally

¹ The collar-like band is well shown in Trelease's plate 69 (Rep. Missouri Bot. Gard. **13**: 1902) and in Purpus' figure (Möller's Deutsch. Gärtn.-Zeit. **28**: 386. 1913).

nearly cylindrical, long, 12–17 to even 23 cm. in length, plump and rounded especially near the base; ripening, it loses its green color and becomes more or less brownish or purplish.

Yucca baccata is found in all the states of the southwest although in the northwestern end of its range it seems to be mainly represented by the variety *vespertina*. *Yucca confinis*, from herbaria records, appears to cross from southeastern Arizona into southwestern New Mexico. *Yucca arizonica* and *Y. Thornberi* are confined, so far as now known, to southeastern Arizona. In regions of interlocking ranges separation, even in the field, is often difficult, especially when no inflorescences are present and the determination of herbarium material is even more unsatisfactory since habit of plant and of inflorescence are such important factors; in such meeting-grounds much more work is necessary to unravel specific identities and range limits; the present study is only preliminary. (See p. 63).

YUCCA BACCATA

Yucca baccata Torrey in Botany, Emory Report, 221 (1859). — Engelmann¹ in S. Watson, Botany, King Report, 496 (1871); in Trans. Acad. Sci. St. Louis, **3**: 44 (1873); in Rothrock Catalogue, Botany, Wheeler Report, 270 (1878), in part, only as to plants of acaulescent habit and northern range. — Coulter in Contrib. U. S. Nat. Herb. **2**: 436 (1891). — Merriam in N. Amer. Fauna, no. 7,352, t. XII. (May 31, 1893). — Coville in Contrib. U. S. Nat. Herb. **4**: 202 (Nov. 29, 1893). — Trelease in Rep. Missouri Bot. Gard. **13**: 109, tt. 68, 69, 85, fig. 4, 97, fig. 2 (range map) (1902).

Yucca sp. Torrey in Botany, Whipple Report, 147 (1856).

SUPPLEMENTARY REFERENCES III. Garten-Zeit. Stuttgart, **21**: 79, fig.² (1877). — Molon, Yucche, 52, fig. 9 (1914). — Jepson, Flora Calif. **1**: pt. VI. 314 (1922); Manual, 247 (1923). — Abrams, Ill. Flora Pacif. States, **1**: 447, fig. 1100 (1923).

Plant commonly simple, acaulescent, occasionally forming small open clumps with 2–6 short, procumbent stems and heads of leaves. Stem scarcely exceeding 1 m. in length, covered with dead, reflexed leaves. Head of leaves rather open, asymmetrical, broader than long, widest below the middle, 0.6–0.75 m. in height 1.3–1.5 m. in breadth, with wide-spreading basal, slightly more erect central and upper leaves. Base of mature leaf considerably broader than long, its median length 5–6.5 cm., its breadth at insertion 10–11.50 cm., at union with blade 3.25–4.50 cm. Blade of mature leaf 50–75 cm. in length, contracted for a short distance above base, then abruptly broadened to middle, thence tapered to apex, greatest width (flattened) 5–5.75 cm., (across concavity) 2.5–4 cm., rarely straight, commonly twisted, asymmetrical, flexible near union with base, elsewhere rigid, for entire length concavo-convex with base of concavity flattened or sharply angled, more or less scabrous on both surfaces, sometimes glaucous, dark blue- or yellow-green (young leaves paler); leaf-margins separating (on upper half of blade) into broad, coarse, flattish, strong, long-persistent, recurved fibres 1.2–2.5 to rarely 10 cm. in length, (on lower half of blade) into curly, wiry, fine fibres; apex thickened, acuminate to acute, often nearly triquetrous; spine short, 1.5–7.0 mm. in length, stout, stiff, only fairly pungent. Inflorescence averaging 0.60–0.75 m. in length overall (scape 10–15 cm. in length, 2.5–4.5 cm. in diameter at base) inflorescence proper narrow below, much broadened above, flat-topped or acute (racemose tip scarcely exceeding tips of uppermost branchlets), ex-

¹ Engelmann references may be found, reprinted, in Trelease and Gray, Botanical Works George Engelmann (1887).

² This illustration appears, variously altered, at least five times: Rep. Comm. Agric. for 1870, 418, t. XXV. figs. 1, 2 (1871); Ill. Hort. **20**: t. 115 (1873); Ill. Garten-Zeit. Stuttgart, l. c.; Garden, **16**: 517, fig. (1879), in part (as to plant) similar to t. of Ill. Hort., l. c., in part (as to fruit) similar to Rep. Comm. Agric., l. c.

ceeding foliage by about 15 cm., at anthesis crowded to open, extremely heavy, fleshy, brittle, glabrous or rarely a little pubescent, smooth to slightly scabrous, green or at first (rhachis, bracts, flower-buds) more or less tinged with reddish purple; at extreme base flowers produced directly on central axis or on abortive branchlets; branchlets about 15 in number (basal 5–20 cm. in length, central and uppermost 5–15 cm.), spreading-ascending (broad forms) or more erect (narrow forms); pedicels 0.7–4.0 cm. in length, terete or slightly flattened, occasionally enlarged at union with flower; bracts on scape few; those above basal leaf-like ones 12–24 cm. in length, 4–5 cm. in breadth at insertion, nearly leaf-like with ill-defined base; uppermost bracts on scape about 10 cm. in length, 5–5.75 cm. in breadth at insertion, triangular-ovate to lance-oblong, mostly thick, leathery, with thinner margins and acute, spinescent apex; bracts at base of lower branchlets very similar to those on upper scape, those at base of central and uppermost branchlets becoming gradually smaller in all proportions, much thickened at insertion, thin, papery along margins, elsewhere soft, thin, suède-like, eventually papery, brittle throughout; bracts at base of pedicels similar in form to those at base of branchlets, 2.5–5 cm. in length, very fragile, often with a median narrow fold or thickening; short, slender, fragile bractlet sometimes present at base of pedicel; flowers extremely variable in size on different plants; 5–13 or even more centimeters in length, campanulate, expanding but little at anthesis, pendent, with base (united portion of perianth) 0.7–1.2 cm. in length, broad-cup-shaped, at times 3-sided, with narrow- to broad-lanceolate perianth-segments thickened (especially those of outer row) in center for entire length, thinner and more or less denticulate along margins and thickened, fleshy-pubescent, hood-shaped at apex; segments of inner row slightly longer, broader (by 5 mm.) than those of outer row; filaments sturdy, 3.25–4.50 cm. in length, united at base in collar-like band 3.2–12 mm. in depth, their major lower portion flattish to slightly convex on both surfaces, fleshy-pubescent, their clavate tip $\frac{1}{5}$ – $\frac{1}{6}$ of the entire filament in length, swollen, at anthesis nearly horizontal; anthers 5–7 mm. in length, the basal lobes $\frac{1}{3}$ of entire length; pistil 5.75–8.25 cm. in length; ovary commonly 4–5, rarely 6–7 times longer than broad (0.7–1.2 cm. in diameter at base), tapered to style, often lop-sided, with uneven surface, with 3 prominent primary fissures and 3 intervening round-to flat-backed lobes marked by 3 inconspicuous secondary fissures; style 5–7 mm. in length, 3.2–5 mm. in diameter, terminating at base in 3 short, obtusish tips, at apex in 3 short, nearly erect, short-emarginate stigmas about as broad at base as long; fruit large, about 17 cm. in length, 5–6.5 cm. in diameter, tapered from base to apex, eventually plump and rounded throughout or with upper third constricted and showing fissures and intervening lobes; old floral base enlarged, thickened, commonly hidden by reflexed perianth and filaments.

Range. Its northern limits extending from the mountains of the eastern Mohave Desert of California across southern Nevada, southwestern Utah and southwestern Colorado as far east as Trinidad; thence south and southeast across northern and central Arizona and the greater part of New Mexico into southwestern Texas. In the northwestern part of this range mainly represented by the variety *vespertina*.

CALIFORNIA. San Bernardino Co.: Cima, June, 1915, *K. Brandegee* (UC). — Vicinity of Bonanza King Mine, east slope of Providence Mts., mountain slopes, 960 m., Lower Sonoran Zone, May 2–24, 1920, *P. A. Munz*, *I. M. Johnston* and *R. D. Harwood* 4113 (PO), 4114 (PO).

NEVADA. Clark Co.: Charleston Mts., "Lincoln Co.," alt. 1585 m., Feb. 17, 1891, *F. V. Coville* and *F. Funston* 310 (W); alt. 1200 m., March 6, 1891, *F. V. Coville* and *F. Funston* 377 (W) (N) (S). — Charleston Mts., east slope, on road to Charleston Park, alt. 2300 m., May 2, 1934, *McKelvey* 4125 (photo. 146–9) (AA). Lincoln Co.: At Quartz Spring, May 27, 1891, *V. Bailey* 1990 (W). — Near Pass south of Bunkerville, Piñon belt, alt. 840 m., April 26, 1919, *I. Tidestrom* 9181 (N) (G). — Pioche, Lower Temperate Life Zone, Aug. 29, 1912, *M. E. Jones* (PO).

UTAH. Washington Co.: St. George, 1870, *J. E. Johnson* (M 135676) (M 135677; in part); St. George, 1874, *J. E. Johnson* (M). — St. George, June, 1870, "Dr. Parry mis [it], 1870," [possibly *Johnson* material] (M 135677; in part). — St. George, 1875, no collector cited (M). — Diamond Valley, alt. 1050 m., April 28, 1894, *M. E. Jones* 5125n (PO); Diamond Valley, 1350 m., April 28, 1894, *M. E. Jones* 5125w (W). Iron Co.: Cedar City, July 6, 1874, *C. C. Parry* (M). Kane Co.: Not far north of Glendale, in wooded canyon, alt. 2000 m., May 12, 1934, *McKelvey* 4346, 4347 (AA). — Between Glendale and Orderville, May 14, 1934, *McKelvey* 4348A (AA). — Approaching Kanab Canyon, June 20, 1933, *A. Eastwood* and *J. T. Howell* 820 (CA). — Kanab, June 17, 1930, *M. E. Jones* (PO). — Kanab, *Mrs. A. P. Thompson* (G; as to leaf only). Grand Co.: Proposed Dam site, near Wilson Mesa, July 1, 1911, *P. A. Rydberg* and *A. O. Garrett* 8397 (N). Grand or San Juan Co.: La Sal Mts., June 2, 1894, *M. E. Jones* (CA); June 12, 1913, *M. E. Jones* (P; as to leaf only).

COLORADO. Montezuma Co.: Hills south of Dolores, alt. 2300 m., June 16, 1892, [? *C. S. Crandall*] 2431 (ACC). Montrose Co.: Naturita, dry hillside, alt. 1525 m., Aug. 28, 1914, *E. Payson* 600 (G) (S) (2 sheets; CU). La Plata Co.: Durango, rock, dry places, common, July 20, 1896, *F. Tweedy* 588 (W). — Durango, Aug., 1894, *C. S. Sargent* (AA). — Durango, May 21, 1916, *A. Eastwood* (CA); June, 1890, *A. Eastwood* (CU). — Just east of Durango, alt. 1980 m., May 25, 1934, *McKelvey* 4636 (AA). — Durango, alt. 1980 m., June 27, 1898, *C. S. Crandall* 2047 (ACC). — Durango, alt. 1980 m., June 24, 1898, *C. S. Crandall* 2430 (N) (ACC). — Rio Animas, common, July, 1875, *T. S. Brandegee* 1078 (M) (P). Archuleta Co.: Piedra, on Chimney Rock Mesa, alt. 2165 m., very dry habitat between *Pinus edulis*, June 26, 1924, *H. M. Schmoll* 1287 (CU). Las Animas Co.: Trinidad, 1868, *C. Thomas* (M); Trinidad, *C. Thomas* (M); Trinidad, 1869, *C. Thomas* (M). — Colorado, *Hayden* (M). — Raton Pass, Colorado side, just south of Morley, May 31, 1934, *McKelvey* 4865 (photo. 155-12) (AA).

ARIZONA. Mohave Co.: Fort Mohave, April, 1884, *J. G. Lemmon and wife* (W) (UC) (PO 183483 probably same; label reads: "Plants of California, *Yucca Whipplei* Torr., Lemmon Herbarium"). — Hualpai Indian Reservation, May 17, 1931, *C. Dudley* 16 (CA). Yavapai Co.: Date Creek, 50 miles south of [Fort] Whipple, June 5, 1865, *E. Coues* and *E. Palmer* 215 (M). — Hillside, May 1, 1903, *M. E. Jones* (PO). — Granite Dells north of Prescott, June 2, 1929, *McKelvey* 1226 (AA). Coconino Co.: Williams, June 8, 1901, *H. S. Barber* 98 (W). — Grand Canyon of Colorado, Sept. 30, *C. S. Sargent* (AA). — Grand Canyon, April 10, 1905, *T. E. Wilcox* (W). — Grand Canyon, Aug. 16, 1901, *W. Trelease* (2 sheets; M); Aug., 1901, *W. Trelease* (M). — Near Powell Monument, Grand Canyon, June 18, 1916, *A. Eastwood* (CA). — Near Bright Angel Hotel, Grand Canyon, June, 1904, *W. R. Dudley* (S). — Bright Angel Trail, Grand Canyon, May 6, 1917, *Mrs. E. Meiere* (CA). — Moran Point, Grand Canyon, June 9, 1901, *L. T. Ward* (W). — South rim of Grand Canyon, Feb. 25, 1920, *E. B. Bartram* 456 (P). — In the desert on outskirts of north boundary of Kaibab Natl. Forest, alt. 1980 m., May 16, 1934, *McKelvey* 4429 (AA). — Bel[l]e mont, July 29, 1892, *J. W. Toumey* 441 (W). — Vicinity of Flagstaff, alt. 2150 m., June 4, 1898, *D. T. MacDougal* 50 (UC) (G) (N) (W) (P). — Common about dry rocky south slope Mt. Elden, 2165-2400 m., Aug. 16, 1923, *H. C. and E. E. Hansen* A816 (M). — Above Thomas Ranch, Oak Creek Canyon, south of Flagstaff, alt. 1600 m., open dry sunny banks, June 14, 1927, *E. B. Babcock* and *D. R. Goddard* 621 (UC). — Oak Creek Canyon, June 7, 1929, *McKelvey* 1274 (AA). — Edge of Painted Desert, Oct. 20, 1928, *A. Eastwood* 15717 (CA). — Padre Canyon, May 20, 1934, *McKelvey* 4491 (AA). — Just west of Padre Canyon, May 8, 1932, *McKelvey* 2754 (AA). — Canyon Diablo, April, 1892, *W. Trelease* (M). — Between Flagstaff and Winslow, May 18, 1931, *McKelvey* 2282 (AA). Gila Co.: Oxbow Hill on road to Payson [from Roosevelt Dam], Nov. 3, 1928, *A. Eastwood* 16660 (CA). — Road to Pleasant Valley, Sierra Ancha, May 7, 1929, *McKelvey* 942 (photo. 8-10) (AA). — Sierra Ancha, juvenile plant, May 10, 1931, *McKelvey* 2149 (AA). — On road to Sierra Ancha, May 7, 1929, *A. Eastwood* 16993 (CA; as to flowers and leaf) (G) [same as *McKelvey* 942]. — Pinal Mts., May 8, 1929, *A. Eastwood* 17024 (CA) (G). — Pinal Mts., April 22, 1934, *McKelvey* 4057 (AA). Apache Co.: About 20 miles northeast of Holbrook, in desert, alt. 1850 m., May 22, 1934, *McKelvey* 4569 (AA). — Fort Defiance, June 2, 1869, *E. Palmer* 123 (W) (M; with notes attached).

Without precise locality: "Southern Utah, northern Arizona, etc.," 1877, *E. Palmer* (2 sheets; M).

NEW MEXICO. San Juan Co.: Tunitcha Mts., above Toadlena, alt. 2300 m., May 24, 1934, *McKelvey* 4610 (AA). Taos Co.: Ojo Caliente, Aug. 24, 1894, *B. H. Smith* (P). Colfax Co.: Raton, April, 1930, *A. Nelson* 10165 (UC) (M). — Above Raton on south slope of Raton Pass, growing below 2150 m. with Pinyon and Juniper but not entering Pine belt, May 31, 1934, *McKelvey* 4863 (photo. 155-10) (AA). McKinley Co.: Above Tohatchi, on road to Chusca Mts., alt. 2300-2450 m., May 21, 1931, *McKelvey* 2310 (AA). Sandoval Co.: Jemez Mts., June 15, 1934, *McKelvey* 4943 (AA). — West slope of Sandia Mts., alt. 2150 m., April 13, 1934, juvenile plant, *McKelvey* 4000, 4001

(AA). — East slope of Sandia Mts., plentiful on rocky slopes, April 13, 1934, *McKelvey* 4008 (AA). Santa Fe Co.: Santa Fe, steep sunny declivities of mountains between rocks, June 3, 1847, *A. Fendler* 849 (M) (P) (G). — Santa Fe, mountainsides, Sept., 1881, *G. E. [ngelmann]* (M). — Santa Fe Canyon 9 miles east of Santa Fe, alt. 2450 m., June 26, 1897, *A. A.* and *E. G. Heller* 3771 (W) (M) (N). San Miguel Co.: Las Vegas, Tecolote, alt. 600 m., July 7, 1927, *Arsène* 18922 (PO). Torrance Co.: Just southwest of Mountainair, May 24, 1931, *McKelvey* 2353-1, 2, 3, 2354 (photo. 110-10) (AA). Guadalupe Co.: Hurrah Creek, [Camp 52, Sept. 25, 1853], *J. M. Bigelow* (W 35875; type) (M 135668; in part from "Cedar Woods") (N). — "Cedar Woods, "Camp 52, Sept. 24, 1853, *J. M. Bigelow* (2 sheets; N) (M 135668; in part from Hurrah Creek). Grant Co.: Copper Mines, May 1, 1851, "Dr. Bigelow who says it is the same as that of Hurrah Creek" (N) (? W 35848; possibly belongs with this Bigelow specimen but bears only a Mex. Boundary Survey label and the number 1479) (M 135667). — Cat Canyon, outskirts of Silver City, April 16, 1934, *McKelvey* 4024 (AA). — Foothills of Pinos Altos, north of Silver City, alt. 2100 m., April 16, 1934, *McKelvey* 4018 (AA). — Silver City, July 10, 1934, (collected by Kellogg) *McKelvey* 4950 (AA). — Santa Rita Mts., May 2, 1931, *McKelvey* 2076 (AA). — Near Silver City, fruit large and when ripe green, May 18, 1880, *E. L. Greene* (M); June, 1880 (PO); May and Oct., 1880 (M). — Dry hills about Silver City, May 11, 1880, *H. H. Rusby* 409 (W). — Near Silver City, alt. 1850 m., Sept. 15, 1903, *O. B. Metcalfe* 697 (M) (N). — Silver City, April 4, 1919, *A. Eastwood* 8207 (CA); May 8, 1919, *A. Eastwood* 8466 (CA). — Burro Mts., March, 1880, *H. H. Rusby* 409 (UC) (W) (N) (2 sheets; M). — Burro Mts., alt. 2000 m., May 2, 1931, *McKelvey* 2077 (AA). — South of Tyrone, Burro Mts., April 17, 1934, *McKelvey* 4025 (AA). — Burro Mts., alt. 1850 m., May 2, 1931, *McKelvey* 2090 (AA). Sierra Co.: Valley of the Rio Grande, [? Sierra Co.], 1856, *Lt. Emory* (N). — About 60 miles south of Socorro, on sides of a rocky, dry canyon, alt. 1770 m., April 15, 1934, *McKelvey* 4014 (AA). Hidalgo Co.: East of Lordsburg, May 5, 1930, *M. E. Jones* 25963 (M). — 31 miles southwest of Lordsburg, alt. 1350 m., April 17, 1932, *McKelvey* 2658 (AA). — About 3 miles west of Lordsburg, May 3, 1931, *McKelvey* 2093, 2094 (AA). Luna or Grant Co.: Road from Deming to Lordsburg, April 17, 1932, *McKelvey* 2657 (AA). Dona Ana Co.: Rincon, April 30, 1884, *M. E. Jones* 4957 (PO) (W). — Organ Mts., [April 29, 30, 1852], *C. Wright* (N); same [date and] locality, "Fls. white, leaves all radical, as long as scape (1½-2 feet high) like Spanish Bayonet," *C. Wright* (G). — Organ



MAP 2. Ranges of *YUCCA BACCATA* (●) and var. *VEPERTINA* (×).

Mts., May 20, 1900, *E. O. Wooton* (PO) (S) (CU). *Otero Co.*: Guadalupe Mts., 0.6–1.0 m. high, Sept. 4, 1902, *V. Bailey* 504 (W). — Sacramento Mts., Alamagordo, dry canyon, alt. 1400 m., April 25, 1902, *J. A. G. Rehn* and *H. L. Viereck* (P) (AA).

TEXAS. *Hudspeth Co.*: Sierra Blanca, April 11, 1930, *M. E. Jones* 25919 (PO; as to flowers only). *Culberson Co.*: On rocky slopes about 5 miles west of Van Horn, April 28, 1931, *McKelvey* 2055 (AA). *Presidio Co.*: About 20 miles north of Shafter, April 26, 1931, *McKelvey* 2011 (AA). *Pecos (?) Co.*: About 14 miles west of Sanderson (Terrell Co.), April 21, 1931, *McKelvey* 1909 (photo. 98–3), 1910 (photo. 97–11) (AA).

The expedition exploring for a railroad route from the Mississippi River to the Pacific passed through eastern New Mexico and made their camp no. 52 on Hurrah Creek, Guadalupe Co.; the nights of September 24 and 25, 1853, were passed there. Lieutenant A. W. Whipple was in charge and under him, as surgeon and botanist, was Dr. J. M. Bigelow. Hurrah Creek flows south and empties into the Pecos River near Santa Rosa; Standley in his *The Type Localities of Plants First Described from New Mexico* (Contrib. U. S. Nat. Herb. 13: 158. 1910), states that the altitude given in the Whipple report is "5,047 feet (1,510 meters)."

Torrey, in his *Description of the General Botanical Collections* of the expedition, wrote: "Dr. Bigelow collected in New Mexico (near Hurrah Creek) specimens of a *Yucca* which seems to be undescribed. The leaves are a foot or more in length, and nearly an inch wide, very thick, entire, abruptly pointed with a short blunt spine, and furnished on the margin (especially towards the base and summit) with coarse tortuous fibres, tapering a little towards the base, and then dilated into a short sheathing base, which is of a brownish-red color. Flowers not seen. Fruit racemose, drooping, oval, as large as a hen's egg, pointed with the thick persistent style. It is of a soft fleshy consistency, and has a sweet taste . . ." Torrey gave no name to the plant at this time.

The Bigelow material from this region is all from Camp 52; that of September 25 is labelled Hurrah Creek, that of September 24, "Cedar woods," but since *Y. baccata* grows almost universally with the red-cedar or juniper this distinction is unimportant. The collections appear on five sheets. Those of September 25 (Hurrah Creek) are: (1) a sheet in the U. S. National Herbarium (W 35875) with two leaves, leaf-fibres and a fruit which answers closely Torrey's description; (2) another in the Torrey Herbarium (N. Y. Bot. Gard.) with a very similar fruit. Those of September 24 ("Cedar woods") are: (3) a sheet in the Torrey Herbarium with one fruit and one leaf, very similar to those noted under (1) above; (4) another with two leaves and an old, nearly racemose inflorescence stalk; the Whipple Expedition label on this sheet bears no notation but a folder containing a bit of leaf-fibre is marked from the "Cedar woods;" it also bears the number 823, possibly a collector's. (5) a sheet at St. Louis (M 135668) with two packets of seeds, one September 25, Hurrah Creek, one September 24, "Cedar woods." The fullest material is that of the sheet (W 35875) described under (1) above.

Torrey also determined the collections made on the United States and Mexican Boundary Survey of which Major W. H. Emory was Commissioner. In his *Botany of the Boundary* Torrey described a new species, *Yucca baccata*, naming two collections, — "Parras, Coahuila; *Thurber*. High table lands between the Rio Grande and the Gila; *Major Emory*." Of the first Torrey wrote that *Thurber* reported the plant as " . . . a tree sometimes twenty-five feet or more in height . . ." Because Bigelow's was " . . . a low species, with subterranean caudex" this *Thurber* material was subsequently referred elsewhere. Dr. N. L. Britton, however, designated it on the sheet as type of *Y. baccata* and Dr. Jepson (1922) cited "type loc. Parras, Coahuila, Mex., *Thurber*;" because of the plant's arborescent habit the writer does not accept it as type; moreover, Torrey practically excluded it from his *Y. baccata* when he stated that "our [*Thurber*']

specimens are hardly sufficient for determining whether it is a described species." The Emory locality has been cited by Standley and others as type locality of *Y. baccata*.

But no specimen has been found labelled "High table lands between the Rio Grande and the Gila" and only one naming Emory as collector. This sheet bears collections of both Bigelow and Emory. One notation read originally: "Mex. Bound. Survey 1-3 Copper Mines N. Mexico May 1, 1851 Dr. Bigelow — who says it is the same species as that of Pecan Creek;" in another hand and ink this was changed to read ". . . the same species as that of Hurrah Creek (not Pecan Creek)." (From J. R. Bartlett's *Personal Narrative* we learn that Bigelow, surgeon of the party, was at the Copper Mines on May 2, 1851, when Bartlett, who had been kicked by a mule, arrived there on that date!) The second notation reads "Valley of the Rio Grande Lt. Emory, 1846." Flowers, foliage and parts of an inflorescence are on the sheet but it is not possible to tell which was Bigelow's, which Emory's; since another sheet in the Engelmann Herbarium (M 135667) bears a flower labelled "Copper mines,¹ New Mexico, Dr. Bigelow May 1st, 1851, ex herb. Torrey," we may be certain that some of the flowers should be associated with the Bigelow label; probably all, for Torrey, who determined most of the plant collections of the 1846-1847 expedition wrote of *Yucca*: "The leaves only, of what appear to be four species of this genus . . . but we cannot identify them for want of the inflorescence." Lieutenant Emory's route in these years is given in his *Military Reconnaissance*; he wrote (p. 136) that "From August 18th [1846] up to the 14th October, all the collections were made in New Mexico, in the valley of the Del Norte [Rio Grande] . . ." and "from the 14th October to the 18th, we were crossing the great dividing ridge [high table lands] between the waters of the Del Norte and the waters of the Gila . . ." His diary gives the precise route across them; it lay in Grant Co. and passed through the Copper Mines (east of Silver City) which Standley tells us was "spoken of by various writers as Santa Rita, Santa Rita del Cobre, Cobre, and the Copper Mines." It seems possible that there may never have been a specimen labelled "High table lands between the Rio Grande and the Gila" and that the phrase merely represented Torrey's concept of the range of *Y. baccata* based on the combined Bigelow-Emory findings. In selecting a type it would have been satisfactory to the writer to have chosen this sheet (since its flowers are unmistakably those of *Y. baccata* and since Torrey cited Emory's collection when he named the species) but the choice seems unjustified because of the inextricable labels and material; nor does Torrey's locality correspond (except in the manner just described) with Emory's label.

Torrey wrote in the *Botany of the Boundary*: "This is the same species that is noticed in the Botany of Whipple's Report as having been found at Hurrah Creek, New Mexico, by Dr. Bigelow. According to Dr. Bigelow it is a low species, with a subterranean caudex. We have no information as to the length of the scape. The flowers appear to form a racemose panicle. They are larger than in any other species of *Yucca* here noticed; the sepals being $2\frac{1}{2}$ -3 inches long, tapering to each end and 6-7 lines wide in the middle. The fruit is the size of a large fig, with a sweet edible pulp." This description, is based largely upon information derived from Bigelow; Torrey's first description of *Y. baccata* (in the Whipple Report) was also based on what he had been told by Bigelow, and it is evident from his text that he had intended to give a name to the species; his choice of name shows that he had the fruit (of the early collection) in mind rather than the flowers. For these reasons the specimen (W 35875) collected at Hurrah Creek by Bigelow, September 25, 1853, is chosen as type; it is unfortunate that the fruit of the specimen is small for it is

¹ In the U. S. Nat. Herbarium is a sheet (W 35848) the flowers of which may have come from Bigelow's "Copper mines" specimen for they look similar. It is cited with a question for there is no date, locality or collector mentioned; "1479" is written on a Mexican Boundary Survey label (citing Bigelow with other collectors) but may be either a collector's or herbarium number.

commonly large in *Y. baccata*. The type locality is Hurrah Creek, Guadalupe Co., New Mexico.

Since first described botanists have interpreted *Y. baccata* in various ways. Torrey's first concept, based in part on Bigelow's statements, was of an acaulescent plant although he considered from Bigelow's reports and specimens that there might be an arborescent variety, *Y. baccata* var. *macrocarpa* Torr., (= *Y. Torreyi* Shafer) further south; when, in 1860, he had seen a specimen collected by the Ives Expedition at Sitgreaves Pass, north-west Arizona, with a stem said to be 1-3 m. high, he noted that "the specimens agree so well in other respects with *Y. baccata* that they must belong to that species." This Ives Expedition specimen (W 35876) represents *Y. schidigera* (*Y. mohavensis* Sarg.)

Engelmann, in 1871, when determining some of the collections of the King Expedition which explored the 40th Parallel, definitely changed Torrey's (and Bigelow's) concept, noting: "stems none, or short, or several feet high . . . Northward a low plant, it becomes a tree farther south;" he cited no specimens but named a wide range, — "From New Mexico and S. Colorado, through S. Utah, to Arizona, California and Mexico." In 1873 he distinguished between *Y. baccata* f. *genuina* and a variety β *australis* stating that "The very full series of specimens before me satisfies me as to the great variability of this species, the extremes of which are so very dissimilar;" nor is Engelmann's f. *genuina* merely an acaulescent *Y. baccata*, — the two are largely distinguished upon size of flowers. Only a few of the specimens cited by Engelmann, and all have been examined, represent *Y. baccata* as understood at present, the rest have been referred to arborescent species.

Engelmann's concept was accepted by Sereno Watson (Proc. Amer. Acad. **14**: 252. 1879; Bot. Calif. **2**: 164. 1880) for, although his descriptions of *Y. baccata* do not seem to include the arborescent forms, these are evidently included because of the range which he named. J. G. Baker (Jour. Linn. Soc. Bot. **18**: 229. 1880) also followed Engelmann.

Coulter, in 1891, cited *Y. baccata* from Texas and his description of flowers, fruit and habit is applicable to that species as now understood; his range, "From western Texas to southern Colorado," also applies; he may have had the plant in mind; his *Botany of Western Texas* was published in 1891, or two years before Merriam and Coville made clear the distinction between the acaulescent *Y. baccata* and the species of arborescent habit. Coulter distinguished two arborescent species indigenous to Texas, *Y. Treculeana* and *Y. australis* (Engelm.) Trelease; he unfortunately cited no specimens for his *Y. baccata*.

Merriam and Coville, after observations made on the Death Valley Expedition, clarified the situation, reducing *Y. baccata* to its original and proper concept. Coville wrote: "From these quotations [Torrey's first description] it is clear that the type form of *Y. baccata* is not the plant with a stout, arborescent trunk, and flowers 3 to 4 cm. long, which ranges from western Texas to southeastern California, and which goes under the simple name of *Y. baccata*;" since 1893, therefore, this species has been better understood.

Although the plant has been confused with other species there are no published synonyms of *Y. baccata*. Engelmann in 1873 cited as such "*Y. crassifila*, Engelm. in sched.;" this name appears on the *Wislizenus* 221 which is here referred to *Y. Torreyi* f. *parviflora*. J. G. Baker (1880) cited "*Y. californica Nuttall herb.*!" There is a specimen presented to the Gray Herbarium by Elias Durand in 1864, which was from the Nuttall collection; on a field label is written *Yucca californica* S. Diego N. Cal. The flowers are those of *Y. schidigera* and the name and specimen have been referred to that species. "*Y. filamentosa* ?, Wood . . ." is cited by Watson (1880) as a synonym of *Y. baccata*; Watson's concept comprised, as already noted, *Y. baccata* and *Y. schidigera*; because of

Wood's description and the locality where his specimen was collected we know that Wood misdetermined his material; his name is referred to *Y. schidigera*.

As here understood *Y. baccata* in typical form is a species of extremely wide range in the southwest and is usually found in small separated colonies. North it has been found by the writer in southern Nevada, southwestern Utah and southern Colorado as far east as Raton Pass south of Trinidad; southeastward from these northern regions she has found it in Arizona, extending from the northern boundary of the Kaibab National Forest through the mountainous central and east-central portions of the state, across New Mexico, and as far southeast as Sanderson, western Terrell Co., Texas, or nearly at the Mexican border. The variety *vespertina*, later described, forms larger, more contiguous colonies and extends the range of the species even further northwest, or into California; it is the predominating form in southern Yavapai and Mohave Cos., Arizona, in southern Nevada and in extreme southwestern Utah; the writer has never found *Y. baccata* in California but, if only because of the prevalence of the variety rather than the typical plant in these adjacent states, the variety should be expected there and herbarium material, the literature and photographs tend to reinforce this supposition.¹

The first collection in California, possibly referable to *Y. baccata*, was made in 1861 by J. C. Cooper on the west slope of the Providence Mts. In 13 herbaria there are only 7 specimens, all from a very limited range in the extreme northeastern end of the Mohave Desert, San Bernardino Co.; while its range in this state is probably restricted it should be more extensive than the four localities of collection (Clark Mt., Cima, Providence and New York Mts.) would indicate. Munz and Johnston, whose specimens are in the Pomona herbarium, state (Bull. Torr. Bot. Club, 49: 33. 1922) that, with *Y. mohavensis* (= *Y. schidigera*) it is common near the Bonanza King Mine in the Providence Mts., the two species differing widely in habitat, habit of growth and in technical characters, — *Y. baccata* found on rocky hillsides in the Pinyon belt and late flowering, *Y. mohavensis* found along the foot of the mountains below the Pinyon belt and early-flowering; they note that Parish's statement (Bot. Gaz. 65: 336. 1918) that *Y. baccata* can be recognized in the field by the paler color of the leaves and universally acaulescent habit is substantiated.² This comment as to the color of the leaves as well as two unusual conditions found in the flowers of *Munz* and *Johnston 4113* reinforce the author's supposition that the variety, not the typical plant, is found in California. This is discussed further under the variety. Their specimen 4113 consists of one extremely small and one more characteristic leaf; both, despite the collectors' comment as to color, are now a dark yellow-green. S. B. Parish at first (Zoe, 4: 349. 1894) did not have the distinctions between *Y. baccata* and *Y. schidigera* clearly in mind and his statements as to the habit of *Y. baccata* (which would seem to point to the occurrence of the typical plant rather than the variety in California and extend the range of the species as far west as the Pacific coast) apply to *Y. schidigera*.

The earliest Nevada collections (three) were made in 1891 by the botanists of the

¹ In the citation of specimens and on the range map the typical plant is frequently indicated from a region which, in the author's opinion, is mainly given over to the variety. For various reasons, such as incomplete material, it has not been possible to classify all specimens satisfactorily; instead of pressing her opinion the writer has referred questionable specimens to the long-accepted, typical form. The apparent prevalence of the typical plant in Nevada (where the writer has found the variety predominating) is explained by Merriam's stations for, although he had *Y. baccata* as distinguished from *Y. schidigera* clearly in mind, he did not comment upon the plant's appearance.

² Munz and Johnston also note (what is here used as a series character) that the perianth-segments of *Y. baccata* do not, as in *Y. mohavensis*, spread from the base but remain erect and adpressed about the ovary for a short distance before spreading, thus suggesting the tubular condition characteristic of the genus *Samuela* Trelease. They also discuss the possibility that there may be a major and minor form of *Y. baccata* because of the variability in size of flower; the writer has found the flowers so universally variable, although all may be classified as large rather than small, that this distinction does not seem justifiable.

Death Valley Expedition; F. V. Coville and F. Funston collected it in the Charleston Mts., "Lincoln Co.," (on recent maps these mountains are included in Clark Co.), — their 310 from "A few kilometers below Clark's sawmill," their 377 from the "West slope of Mountain Spring Pass;" *V. Bailey 1990* came from Quartz Spring which Merriam located ". . . at the west base of the Desert Mountains in the north arm of Indian Spring Valley;" these mountains extend northeastward, across the present line of Clark and Lincoln Cos. *Coville and Funston 310, 377* and *Bailey 1990* (flowers only) in the opinion of the writer seem to represent the variety because of the long-stipitate flower-base and apparent lack of articulation between this base and the pedicel; this is discussed under the variety. We have better records of occurrence for Nevada than for any other state with the possible exception of New Mexico, since Dr. Merriam (who distinguished clearly between *Y. baccata* and *Y. schidigera*, the only other species with which it might possibly have been confused in the state) was explicit as to its range. He recorded *Y. baccata* from Clark and Lincoln Cos. His report indicates that it approaches the border of Nye Co., both in the Charleston Mts. (south) and in the Timpahute Mts. (north), the last probably the most northern record west; he cited it from as far northeast as the Pahroc, Highland and Juniper Mts., from Indian Spring and Pahrangat Valley, etc., and from the Desert and Hyko Mts.; the lowest altitude which he mentions is 1250 m. (Pahrangat Mts.), the highest 2000 m. (Juniper Mts.); he noted that it begins at 1325 m. in the Charleston Mts. (east slope) and at 1400 m. (west slope). Merriam's plate XII shows a plant of simple, acaulescent habit, very similar to typical *Y. baccata* except that the head of leaves is more symmetrical and more constricted below and spreading above than is common on that form; a similar photograph in the Missouri Botanical Garden states that it was taken by Merriam May 27, 1891, at Hungry Hill Summit; his "List of Localities . . ." tells us that this is "A divide in the Desert Mountains between Emigrant Valley and the head of the north arm of Indian Spring Valley." The writer took a picture (see pl. IX) of just such a plant in the Charleston Mts., but in the same region took others of plants far different in appearance (see pl. XIV) and representing the variety rather than the typical plant. Tidestrom's collection from Bunkerville, northeastern Clark Co., Nevada, represents the typical plant; his *Flora of Utah and Nevada* (Contrib. U. S. Nat. Herb. **25**: 126. 1925) records *Y. baccata* as a plant of the "Dry mesas of the artemesia belt."

In southeastern Nevada, on the east slopes of the Charleston Mts., the writer found, in early May, 1934, both the typical plant and the variety, the latter predominating. In these mountains the relationship between altitude and flowering season was well demonstrated; the plants began at about 1525 m. (but flowers had gone by) and extended to 2450 m. (where as yet they were not in bud); they were in perfection of bloom at 2150 m., in bud at 2300 m. The altitude range of three species (*Y. baccata*, *Y. schidigera*, *Y. brevifolia*) was also well demonstrated; that of *Y. baccata* has been given; *Y. schidigera* was plentiful in the desert at about 900 m. and extended to 1675 m.; for about 150 m. of its upper range it intermingled with the lower range of *Y. baccata*; *Y. brevifolia* began in the desert at about 1050 m. and extended to 2000 m. where it was plentiful in the Juniper and Pinyon belt; for 450 m. its range interlocked with that of *Y. baccata*, for 600 m. with that of *Y. schidigera*. Further south, near the Yellow Pine Mine, in the Spring Mts., the variety again predominated; here, at 1450 m., flowers had mainly gone by and fruit was of fair size; the clumps were dense and confused and suggestive of those seen in the region of the Acquarius Mts. of Arizona.

In Utah *Y. baccata* was first collected in 1870, near St. George, Washington Co., by J. E. Johnson and at Cedar City, Iron Co., by C. C. Parry; the Johnson specimen is of foliage and suggests the typical plant; one old rhachis (the label reads "St. George, 1875")

and the date indicates that it formed part of the Johnson or Parry collections) because of its small size and few branchlets suggests the variety rather than the typical plant. Merriam only cited *Y. baccata* from the Upper Santa Clara Valley, north of St. George, and from the Beaverdam Mts.; he gave its altitude range in the Valley as 1150–1200 m. and stated that in the Beaverdam Mts. it descends to 1100 m. (east slope) and 1025 m. (west slope). Rydberg and Garrett collected it in Grand Co. and M. E. Jones at Diamond Valley in the La Sal Mts., which extend from Grand Co. into San Juan Co.

In extreme southwestern Utah the writer found *Y. baccata* at 1150 m., or growing considerably lower than in the Charleston Mts. of Nevada; the plants were presumably outposts from the Beaverdam Mts. slightly further north; in these mountains it was plentiful from 1250–1525 m. and in fine flower May 5, 1934; it undoubtedly mounted higher. It was found in a rocky canyon northwest of St. George in the Santa Clara Valley. It was seen, intermittently, from St. George to Zion National Park and collected within the Park boundaries. Principally in the Juniper and Pinyon belt it extended intermittently for some distance northeast of St. George, along the western side of the divide which runs north and south in the southwestern part of the state, but was not seen as far north as Cove Fort where the divide was crossed. In all these regions the variety was common, the typical form rare. To the east of the divide just mentioned, from the region about Glendale southward toward Kanab, the reverse was the case, — the typical plant the common representative; intermediates were plentiful (see pl. XV).

In 1868 Cyrus Thomas, working with F. V. Hayden's geological survey, first collected *Y. baccata* in Colorado, in the Trinidad section, Las Animas Co. In southwestern Colorado the plant is plentiful but there are few specimens in herbaria. Its range in the state is best defined in Merritt Cary's *Biological Survey of Colorado* (N. Amer. Fauna, no. 33). He cited it among "Plants of the southwestern section — Colorado River drainage," and noted that "This region is especially marked by a large number of Upper Sonoran desert shrubs and plants, most of which extend into Colorado only a short distance on the west and southwest, being peculiar to the desert areas of the southwestern United States;" he named *Y. baccata* among conspicuous plants of the Juniper and Pinyon belt, and as growing "chiefly among rocks on warm juniper slopes and in the lowest valleys;" of its occurrence he wrote: "It was flowering at Mesa Verde at 7,000 ft. June 13, 1907, the spikes of large greenish white flowers dotting the rocky rims of Navajo Canyon just above the Spruce Tree Cliff Ruins. (See fig. 34 [this shows a group of plants not very different in appearance from the variety as it grows about Peach Spring, Mohave Co., Arizona].) I observed this yucca at Arboles; Bayfield; McElmo; Coventry; on slopes bordering Paradox and Sinbad Valleys; and along the canyon of Dolores River between Salt Canyon and the mouth of West Creek. There appears to be only one Colorado record for *Y. baccata* east of the mountains — Rydberg recording it from Trinidad." Cary's stations are all in the southwestern end of the state, the most northerly the canyon of the Dolores River. Mr. D. M. Andrews of Boulder referred (Nat. Hort. Mag. 2: no. 3,232, fig. 1932) to the leaves of the Colorado plant as "thick and wide, and deeply channeled like an agave;" his photograph shows a plant of the typical form with open heads of few, wide-spreading leaves; he referred to the fruit, which in the picture is so heavy that it lies upon the ground, as "not unlike a cucumber . . ." Because of the fruit's swollen appearance this seems a better comparison than the more common one to the banana; this photograph, enlarged, was presented to the Arnold Arboretum by Mr. Andrews and a note states that it was taken at Durango. Plants very similar in appearance have been seen by the writer both at Durango and about Trinidad although many had even fewer heads of leaves. In Colorado the writer found *Y. baccata* (in typical form only) in the La Plata

Range, east of Mancos, Montezuma Co., and fruit was collected just east of Durango, La Plata Co.; flowers were collected and photographed south of Morley (at the north end of Raton Pass), Las Animas Co., where it grew high on the mountain slopes (see pl. XII).

In Arizona *Y. baccata* was first collected June 5, 1865, at Date Creek, 50 miles south of [Fort] Whipple [near Prescott] by E. Coues and E. Palmer (no. 215); although possibly from that part of Date Creek where Palmer in 1869 made collections of the Joshua-tree (here selected as type of *Y. brevifolia* Engelm.) it seems more probable that it came from further east or from north of Congress Junction where the plant is plentiful, for this region falls more nearly within the 50 miles south of Prescott. (Palmer also collected it at the opposite end of the state, at Fort Defiance, Apache Co., near the New Mexico line, in 1869.)

In typical form it is plentiful in Coconino Co. It was found as far north as the northern boundary of the Kaibab National Forest (near Fredonia and the Utah line) where it grew on the outskirts of the desert; here it spread west towards Moguitch Canyon (probably into Mohave Co.); eastward it was seen near the base of the descent from Jacob's Lake to Houserock, again extending a short way into the desert. After passing Cedar Spring south of Lees Ferry, one plant was seen (in this region it could not have been any other species) with an erect stem about 1.30 m. tall; unfortunately there were no flowers. It is plentiful on both sides of the Grand Canyon; the writer saw it below the north rim and many persons have collected it along and over the south rim. It abounds about Flagstaff and westward towards Ash Fork; eastward it is plentiful in Padre Canyon and in Canyon Diablo but stops in this direction and is replaced by capsular-fruited yuccas when, to the west of Winslow, the rugged juniper country changes abruptly to flat and arid desert; south of Flagstaff it is found in Oak Creek Canyon; north it was collected on Mt. Elden in the San Francisco Mts. by the Hansens and excellent photographs were taken of it by A. Purpus (Möller's *Deutsch. Gärt.-Zeit.* 28: 375, 3 figs. 1913) on Mt. Elden.¹

In Apache Co. it was seen in open grasslands east of the Petrified Forest, an unexpected region; the same day while an electric storm was at its worst a single plant was seen (but not collected!) upon a hill east of Springerville; further northwest in this county (or perhaps Navajo Co.) it was flowering in the desert some miles northeast of Holbrook; associated with the pinyon belt its infrequent occurrences in the desert always came as a surprise; it undoubtedly occurs in the Arizona extensions of the Chusca and Carrizo Mts. further north, although records from these mountains are from the New Mexico side. In Yavapai Co. it was collected about Prescott; here the variety and intermediates are common and photographs were taken showing the various forms. In Gila Co. it was found and photographed in the Mazatzal Range west of Roosevelt Dam and in the Sierra Ancha northeast; here it seems to occur at higher elevations than the many confusing plants of somewhat similar appearance which are discussed following *Y. Thornberi*.

In New Mexico the first collection of *Y. baccata* was made by Fendler (his no. 849) at Santa Fe, June 3, 1847; its flowers are unusually small.² Charles Wright who accom-

¹ Merriam (N. Amer. Fauna, no. 3, 1890), in discussing the Pinyon zone of the San Francisco Mountains region with approximate elevation of 1800–2100 m., stated (p. 12) that "Near the Grand Cañon of the Colorado and again at Walnut Cañon, where the lava rock gives place to limestone . . . *Yucca angustifolia* replaces *Yucca baccata*;" again (p. 35): "While the San Francisco Mountain Plateau is composed of lava, the Cocanini Plateau is carboniferous limestone. The resulting difference in soil affects the vegetation, and many plants grow in the piñon belt at the cañon which are not found in the same belt on the lava . . ." Among those of the pinyon zone he cited *Y. baccata*.

² Fendler 849 is found in the Missouri Botanical Garden, in the Philadelphia Academy and in the Gray Herbarium. Another sheet (M 140580) probably formed part of this collection (the section of stem is similar to that of the Gray Herbarium sheet and the foliage on all four sheets is the same) but no indication of its origin is given.

panied the Emory Expedition, next gathered it in the Organ Mts., Dona Ana Co., en route to Mexico; the precise date of collection is not given but Professor Wooton, who worked out Wright's itinerary from his field books, states that Wright was in these mountains on April 29 and 30, 1852 (see Wooton in Bull. Torr. Bot. Club, **33**: 1906; Standley in Contrib. U. S. Nat. Herb. **13**: pt. 6, 1910).

The writer has never traveled in Otero, Chaves, Eddy or Lea Cos. of southeastern New Mexico but has been in parts at least of the other counties of the state with the exception of Harding and Quay Cos. in the northeast. In Guadalupe Co. she has not been to Hurrah Creek, the type locality, but is familiar with the plant in adjacent counties west and northwest and the material of the type and of the other specimens from the same locality is very similar to what has been seen in these nearby regions. In all parts of New Mexico visited the plants seemed to represent the typical form rather than the variety; herbarium material corroborates this.

The Silver City region was visited twice by the writer; in 1931 the season was late and about Santa Rita and Silver City only leaves were collected but in the Burro Mts. a little further south, *Y. baccata* was in bud at high and in flower at low altitudes; in 1934 buds were sufficiently advanced about Silver City to prove that *Y. baccata*, not *Y. Torreyi*, is the species found in this region. Wooton and Standley's *Flora of New Mexico* (Contrib. U. S. Nat. Herb. **19**: 137. 1915) reports *Y. Torreyi* from Fort Bayard and from Silver City but all specimens seen from these regions appear to be *Y. baccata*. From this mountainous portion of Grant Co. the plant descends southward into the desert and is found in the flat country east and west of Lordsburg, Hidalgo Co.; the elevation at Silver City is about 1750 m., at Lordsburg some 480 m. lower. It is possible that further study may prove that some of the plants (all of the Baccatae series) found between Lordsburg and the Arizona line represent, not *Y. baccata*, but *Y. Thornberi*, which approaches the region in the San Simon Valley and in the Chiricahua Mts., or *Y. arizonica*, although this last species is more to be expected in the Bisbee region near the Mexican line. Standley records *Y. baccata* from the Florida Mts., Luna Co., but no specimens from these mountains have been located.

In New Mexico, from other counties adjacent to the Mexican border, we find specimens from Rincon (close to Sierra Co.) and from the Organ Mts., Dona Ana Co.; Vernon Bailey collected it in the Guadalupe Mts., southeastern Otero Co., and Rehn and Viereck at Alamogordo, in the Sacramento Mts. Northward, following an east to west, west to east course through the state, we have the following records: in Sierra Co. the writer collected it near Elephant Butte Reservoir and Standley at Fairview; there is no record from Catron Co. although it occurs not far east in Arizona and might be expected in the mountains north and west of the Plains of St. Augustine; there is no record from Valencia Co. although the writer believes that she remembers it in the Zuni and San Mateo Mts.; in Bernalillo Co. it grows among the boulders covering the base of the Sandia Mts. not far east of Albuquerque, as well as further east along the road to Moriarty. Southwest of Mountainair, Torrance Co. (elevation ca. 2000 m.), plants were coming into perfect bloom May 24, 1931, and both true and bogus Yucca moths (determined by Dr. August Busck as *Tegeticula alba* and *Prodoxus coloradensis* respectively) were present in astonishing numbers in the late afternoon; the perfect condition of the inflorescence rather than the hour of day would seem to determine the presence or absence of moths, for when even a few flowers are going by on the inflorescences they are not apt to be found; they are undoubtedly more active late in the day or at night; after a long day of travel in the arid regions east of Willard, where only capsular species were to be found, it was surprising to run suddenly into the Pinyon belt and to find *Y. baccata*; this day Mountainair seemed a

delightful green oasis but, on a subsequent visit in 1934, prolonged drought and a bad dust storm completely effaced the first impression of verdure! These plants represented typical *Y. baccata*; they were acaulescent, often solitary, the leaves considerably broadened, coarsely filiferous near the tip, the large inflorescences wide-spreading above, scarcely exerted, fleshy, with longish branchlets, the flowers campanulate, variable in size and in form of corolla-segments, the pistil large with long, tapering ovary, short, parallel-sided style and erect stigmas; on one inflorescence some flowers suggested those of *Y. Torreyi* in that the filaments were occasionally free from each other at base instead of united in the collar-like band and the base of the flower often gibbose rather than cup-shaped; many flowers were double, abnormal, and numerous inflorescence branchlets fasciate and suggestive of hybridity; the nearest record for *Y. Torreyi* is Alamagordo, Sacramento Mts. From Guadalupe Co. there are only the Bigelow specimens from Hurrah Creek; from San Miguel Co. there is one specimen with abnormally short leaves from near Las Vegas; in Santa Fe Co. the plant is common; the writer has seen it near Golden and in the mountains about Santa Fe and others have collected it thereabouts; from Santa Fe came the first collection made in New Mexico, *Fendler 849*; in Sandoval Co. the writer collected it on west and east slopes of the Sandia Mts. (crossing from Placitas to Madrid) and in the Jemez Mts. near the middle of the county; in McKinley Co. she found it in the Chusca Mts. southwest of Tohatchi; Standley reports it from Farmington and the Carrizo Mts. in northwestern San Juan Co., and the author found it above Toadlena in the Tunitcha Mts., entering these from Newcomb; in the Chusca and Tunitcha Mts. it grew at high elevations (about 1800–2750 m.) becoming less plentiful upwards; in Rio Carriba Co. it was seen in Rio Grande Canyon en route to Taos; there is one specimen from Ojo Caliente, Taos Co.; in eastern Colfax Co. it was seen at about 2400 m. on the lower slopes of the Raton (?) Mts., in the Maxwell Grant; flowers were collected and photographed on the south (New Mexico) side of Raton Pass (see pl. X).

Vernon Bailey, in *Life Zones and Crop Zones of New Mexico* (N. Amer. Fauna, no. 35, 28, 1913), cited *Y. baccata* among the most characteristic plants, excluding grasses, of the open plains and valleys of the Upper Sonoran zone of the Rio Grande Valley of New Mexico.

From Texas there is a specimen, *M. E. Jones 25919*, from Sierra Blanca, Hudspeth Co., April 11, 1930; the writer identifies the leaf of the sheet (PO 178281) as *Y. Faxoniana*, the flowers as *Y. baccata*; Jones determined the material as *Y. canaliculata* [= *Y. Treculeana*]. This would seem to be the earliest collection of *Y. baccata* from Texas, antedating the writer's material by about one year; although she has never seen *Y. baccata* about Sierra Blanca it is entirely possible that it grows there. Jones failed to differentiate the several yuccas of the region; this is apparent for in another instance his Sierra Blanca collections, also determined as *Y. canaliculata*, represent instead both *Y. Faxoniana* and *Y. Torreyi*.¹

The writer first found *Y. baccata* in Pecos (?) Co., Texas, about 14 miles west of

¹ There are several M. E. Jones specimens which are numerically out of sequence in relation to their cited dates and localities; they are of interest because of the possibility that they represent Texas collections of Baccatae series; it has been possible to verify the collector's numbers (not always legible) since the material was widely distributed; in numerical sequence they are: no. 28399, Dragoon, Arizona, April 14, 1931 (PO 190247; UC 479040; M 1013601); no. 28400, Kerrville to San Antonio, Texas, April 23, 1931 (PO 190237; M 1013603); no. 28402, Kent [Culberson Co.], Texas, April 18, 1931 (PO 190248; UC 479041; no. 28403, San Simon, Arizona, April 15, 1931 (PO 190229; UC 479038; M 1013602; S 220063); the flowers of no. 28400 belong to the Baccatae series and have been referred to *Y. Thornberi*; the writer does not believe that any species of the Baccatae series occurs so far east, even approximately, as the San Antonio region and feels that this specimen must have been associated with the wrong locality and date, and probably came (as did nos. 28399, 28403) from the region of Dragoon and San Simon respectively, in southeastern Arizona; the no. 28402 is *Y. Torreyi* (Pomona sheet) and the bulk of the material (University of California sheet) is *Y. Torreyi* although two loose flowers in a folder belong to the Baccatae series; the nos. 28399, 28403 have been referred to *Y. Thornberi*.

Sanderson, Terrell Co., the elevation 750–900 m.; it was in full flower April 21, 1931, while *Y. Torreyi*, plentiful in the immediate vicinity, had entirely gone by. The often extremely large, campanulate flowers had all the characters which are to be expected in the species but were very variable in form on different plants (see pl. XI); in 1932, when it was hoped to find fruit the plants had not flowered. *Y. baccata* that year was found as far east as Sanderson, Terrell Co., and was distinct from juvenile, acaulescent *Y. Torreyi* of about the same size; even without flowers these species are easily separable for *Y. baccata* has but a few wide-spreading leaves with broad, often twisted blade with coarsely filiferous margins and a thickened, acutish apex, while *Y. Torreyi* has more numerous leaves held stiffly in an erect-ascending position, the blade little broadened, straight, rigid, with fine fibres along the margins and a more tapering apex. West of Alpine, Brewster Co., plants were seen which, even without flowers, were believed to be *Y. baccata* because of these foliage and habit characters. In Presidio Co., about 20 miles north of Shafter in the Big Bend, flowers were collected, and on the western outskirts of Van Horn, Culberson Co., still others. Some of the above collections, like those from Mountainair, New Mexico, were unstable in floral structure; they resembled *Y. baccata* in habit, inflorescence and foliage but at times suggested *Y. Torreyi* in the occasionally gibbose rather than cup-shaped base, the more slender ovary with tapered neck and longer, more spreading stigmas; also in some the filaments failed to unite into the collar-like band of the Baccatae series (sometimes only a few filaments in a flower, again all in a flower); *Y. Torreyi* is the common species of western Texas and, in every region where *Y. baccata* was found, grew adjacent to it; it seems not impossible that some relationship, perhaps remote, may be indicated by these instabilities. Mountain ranges are many in western Texas; *Y. baccata* probably is to be found in them at higher elevations, the plants seen representing extensions into lower, desert areas; Trelease's range map (t. 97, fig. 2) shows central Arizona and central New Mexico as the southern limit of this species but it now seems reasonable to suppose that it extends south into the mountains of Chihuahua, Mexico.

Apart from the writer's collections and those of M. E. Jones no Texan specimens of *Y. baccata* have been located, even in the herbarium of the University of Texas. Elihu Hall (*Plantae Texanae*, 23, 1873) lists two yuccas, one of which (no. 648) was determined as *Y. baccata*; in the New York Botanical Garden herbarium *Hall 648* is a capsular species. Vernon Bailey (*N. Amer. Fauna*, no. 25, 33, 1905) cites *Y. baccata* among the plants characteristic of the mountain region of the Upper Austral zone, Upper Sonoran division, of the country west of the Pecos, but no Bailey collections from Texas have been found. Britton and Brown (*Ill. Flora*, ed 2, 1: 512, fig. 1277, 1913) cite, under the range of *Y. baccata*, "Western Kansas (?)" and "Mexico;" no records known to the writer authenticate this distribution; the first seems improbable, the last entirely possible.

Much that has been written on the economic uses of "*Y. baccata*" undoubtedly refers, in part at least, to such plants as *Y. Torreyi* and *Y. schidigera*. Standley's *Some Useful Native Plants of New Mexico* (Smiths. Rep. for 1911, 452, t. 8, 1912) is applicable to *Y. baccata* unless his text states otherwise; he wrote: "The yucca which is of greatest economic importance, perhaps, is the datil (*Yucca baccata*, pl. 8), which grows in the foothills of the northern part of the State in great abundance, and extends in lessened numbers south to the Mexican border. It is one of the low forms, never more than 2 or 3 feet high, but is noteworthy from the fact that its fruit, unlike that of other species, is fleshy and edible. In form the fruit is cylindrical or conical and usually 6 inches long, with a smooth skin. When ripe it somewhat suggests a banana, because of its shape and yellow color, and is palatable despite the large black seeds with which it is filled. No use has ever been made of it by the English-speaking people and little by those of Spanish

descent, but it was an important food among the Indians, who do not altogether ignore it now. The Navahos made more extensive use of it than any other tribe, possibly because the plant grows so luxuriantly in their territory, where it sometimes covers the foothills with almost unbroken ranks.¹ Regular expeditions were made to gather the fruit when it was ripe. Some of it was eaten fresh, either raw or cooked, but often it was preserved for winter use. The ripe fruits were dried by the fire on flat stones, then ground and kneaded into small cakes, which were laid in the sun and allowed to dry still further. These cakes were stored until wanted, when they were broken up and mixed with water and in this form eaten with bread, meat, or other dishes. . . The roots of all yuccas contain a high percentage of saponin and are employed as detergents. After being dug and grated or otherwise reduced to small particles they are used almost exactly as soap, forming a copious and persistent lather. Both the Indians and the Mexican population use the soap weed in this form, especially for washing the hair. The ground root, amole, is said to be superior to soap for many purposes. In small amounts it has been placed upon the market, where, if its merits were better known, doubtless a profitable sale could be found for it. . . Yucca leaves furnished the Indians with the most satisfactory material for their basketry. . . From the interior of the yucca leaf is taken the nearly white fiber which forms the groundwork of the basket. The geometrical designs with which these are customarily decorated are worked in with strips from the outer coarser part of the leaf, of a soft greenish-yellow color. . . Not all Indian baskets made in New Mexico are woven from these materials, but most of them are substantially the same. . . Because of the prominence and strength of their fibro-vascular bundles Yucca leaves have been considered as a possible source of fiber for cordage, but they are not well suited to such a purpose since their product is coarse and hard. On a small scale the leaves have been made into heavy stable brooms and there is a possibility of a more extensive utilization in this direction."

Other references to the economic uses of *Y. baccata* are: E. Palmer (Amer. Naturalist, **12**: , Sept., Oct. 1878). — V. Havard (Proc. U. S. Nat. Museum, **8**: no. 33, 516. 1885; Bull. Torr. Bot. Club, **22**: 119. 1895; **23**: 37. 1896). — A. Eastwood (Zoe, **3**: 375. 1893). — C. R. Dodge (U. S. Dept. Agric. Fiber Investigations, Report no. 9, 331. 1897).

E. O. Wooton's paper, *Certain Desert Plants as Emergency Stock Feed* (U. S. Dept. Agric. Bull. no. 728, t. 7, fig. 2. 1918) refers to this species and to other yuccas; there is a picture of *Y. baccata* in bloom in the San Andreas Mts. of New Mexico; a table gives the chemical analysis of different emergency feeds and a map shows the occurrence of the different species discussed in the article.

The *Report of the [U. S.] Commissioner for Agriculture for the year 1870* (418, t. 25, figs. 1, 2. 1871) purports to refer to *Y. baccata* but, because the old flower-base differs in the two fruits illustrated, probably refers as well to other species; this report cites an instance which may deter readers from partaking too bountifully of *Yucca* fruit, despite the frequent references in the literature to its edible qualities: ". . . On one occasion the troops in Northern Arizona captured a quantity of the dried fruit from the Apaches, and, being sweet, it was generally eaten; and for sometime neither salts nor castor-oil were needed from the medicine-chest, as this fruit proved to be a vigorous cathartic when dry. . ."

The literature tells us nothing of the cultivation of *Y. baccata* in the United States although British and European periodicals often refer to its introduction and culture in England and abroad.

¹ The writer has never seen typical *Y. baccata* growing in "almost unbroken ranks;" the variety, which often forms dense stands, may be more widespread than she supposes and extend further east or into some of the Navajo country.

Ortgies writing of Roezl's collections (Gartenflora, **23**: footnote p. 51. 1874; Belg. Hort. **30**: 266. 1880) quotes the collector as stating that he brought back to Europe plants and four fruits of *Y. baccata* from the "Montagnes Rocheuses" of New Mexico; the paucity of fruit was explained by the fact that the Indians, or "indigènes," had preceded him in the field; in view of Roezl's greed as a collector (see *Y. schidigera*) the writer derives some satisfaction from this fact! The plants and fruit were sold to Linden, a nurseryman of Brussels, who, soon after, is said to have advertised them in his catalogue. Ortgies states that the fruit resembles in form, dimensions, "*et le goût* [*italics mine*] à ceux du *Musa Cavendishi*;" indeed, advertising must have stretched several points since "W. G." (Garden, **16**: 516, fig. 1879) writes that the flowers are "said to be deliciously fragrant," which is certainly not the case. *Yucca baccata* may have been introduced by others than Roezl; André (Ill. Hort. **20**: 23, t. 115. 1873) notes that Linden introduced it in 1872 but because of his description of the plant's habit, André may have been writing of *Y. Treculeana*; Bellair and St. Léger (Pl. Serres, 1618, fig. 622, no. 2, 1900) refer to it as introduced from Colorado in 1873; André (Rev. Hort. 1887, 368, figs. 73, 74, 75; reprinted in Garden, **35**: 585, fig. 1889) writes that it comes from Mexico and does superbly on the Mediterranean, flowering at Mr. Deleuile's in Marseilles; one of his pictures shows the long pistil characteristic of the Baccatae series; he notes that the owner has produced plants far superior to the original introduction; Purpus (Möller's Deutsch. Gärtn.-Zeit. **28**: 375, 3 figs. 1913) gives three excellent photographs of *Y. baccata*, — one shows the plant growing on Mt. Elden near Flagstaff, another in bloom at Darmstadt, a third the fruit.

Probably the first *Y. baccata* to bloom in England grew in the garden of the Rev. Henry Ewbank, at Ryde, Isle of Wight (Garden, **58**: 81, fig. 1900; Gard. Chron. ser. 3, **28**: 103, fig. 27. 1900); it flowered about 25 years after planting and evidently to the great surprise of the owner; his photograph shows that cultivation had in no way changed the plant's appearance from the wild state. Ewbank wrote at length about it: while it was in bloom he was visited by a Mr. Corrie who had been in Brazil and had seen a great part of the world and who was "quite certain that *Yucca baccata* as he had been accustomed to see it had a long stem which was more like a telegraph pole than anything else;" Ewbank, who up to then had evidently been quite satisfied with the stemless habit of his plant, considered this "a disconcerting fact so far as identification was concerned;" the two friends got out Nicholson's "Horticultural Bible" and found *Y. baccata* described as "8 to 10 feet or . . . stemless," and Ewbank notes that "this clears up the whole thing in my eyes;" after weathering this nomenclatorial storm (although incorrectly), an actual tempest occurred so that the plant was "knocked about," and the article ends with the regrettable information that it "is now a perfect picture of the most abject misery that could be conceived — a downright floral wreck." Most garden enthusiasts have had similar experiences, both as to helpful friends and unfriendly elements!

***Yucca baccata* var. *vespertina*,¹ var. nov.**

Plant acaulescent with many short, procumbent or slightly longer, more erect stems and forming dense, confused clumps. Head of leaves asymmetrical, most often constricted below, spreading above. Blade of leaf commonly short (in some regions extremely long), always narrow, concave (the concavity sharply angled for its entire length), twisted, falcate, variously curved, pale blue- or sage-green; leaf-margins separating into fine (rarely coarse) straight to curly, wiry fibres. Inflorescence inconspicuous, small, short

¹ A planta typica recedit habitu denso caespitoso, truncis interdum suberectis, foliis pallida coeruleo- vel cinereo-viridibus angustioribus valde curvatis vel tortis vel falcatis magis concavis et manifeste angustatis, margine filis plerumque tenuioribus et longioribus, inflorescentia breviorae saepe tantum 30-45 cm. longa mox lignescens ramis paucioribus plerumque 10-12, sub anthesi colore intense rubro vel brunneo suffusa, ceterum ut in typo.

(scape short, slender), soon ligneous; inflorescence proper commonly broad below, narrow above with acute apex (racemose tip exceeding tips of uppermost branchlets), scarcely exceeding foliage, at anthesis open, few flowered, much colored (rhachis, bracts, flower buds, open flowers) with dark reddish purple; branchlets few, 10–12 in number; flowers at anthesis commonly dark-colored without, more frequently abnormal than those of typical plant, often long-stipitate below the cup-shaped base and often seeming to lack articulation between base and pedicel.

Range. Predominating, although the typical plant may at times be present, in northeastern San Bernardino Co., California, in southern Nevada, in extreme southwestern Utah, and in Mohave and Yavapai Cos., Arizona. For range map see p. 33.

CALIFORNIA. San Bernardino Co.: Clark Mt., common, dry slopes, alt. 1500 m., Sept. 15, 1932, *P. A. Munz 12871* (PO) (UC). — Providence Mts., May 26, 1902, *T. S. Brandegee* (UC). — Western slope of Providence Mts., May 29, 1861, *J. G. Cooper* (M). — New York Mts., Barnwell, June 4, 1915, *S. B. Parish 10281* (G) (UC) (S). — Lower slopes of New York Mts., near Ivanpah, alt. 1250 m., April 21, 1932, *R. S. Ferris* and *R. Bacigalupi 8092* (UC) (S).

NEVADA. Clark Co.: Yellow Pine Mine, Spring Mts., May 3, 1934, *McKelvey 4144-1, 2, 3* (AA). — Bird Spring Range near Las Vegas, March 29, 1934, *I. T. Kelly* (CA). — Charleston Mts., east slope, on road to Charleston Park, alt. 2300 m., May 2, 1934, *McKelvey 4115-1, 2, 3, 4133, 4134* (photo. 146-12); alt. 2135 m., *McKelvey 4135-1, 2* (AA). — Kyle Canyon, Charleston Mts., gravelly wash and hillsides, Juniper belt, alt. 1800 m., May 10, 1936, *I. W. Clokey* and *E. G. Anderson 7053, 7054* (G).

UTAH. Washington Co.: Beaverdam Mts., alt. 1500 m., May 5, 1934, *McKelvey 4161* (AA). — In ravines northwest of St. George, Santa Clara Valley, May 6, 1934, *McKelvey 4177* (AA). — Zion Natl. Park, *McKelvey 4226* (AA).

ARIZONA. Mohave Co.: Near Burro Creek in Acquarius Mts., March 29, 1930, *McKelvey 1652* (photo. 81-11) (AA). — East of Drake, Aug. 20, 1901, *W. Trelease* (M). — Vicinity of Kingman, spring 1927, *S. Braem* (S) (AA). — Kingman, April 15, 1931, *A. Eastwood 18047* (CA); April 17, 1931, *A. Eastwood* (CA); April, 1931, *A. Eastwood* (CA; excluding *Nolina* leaf). — Just west of Kingman, May 4, 1932, *McKelvey 2738-1, 2, 3, 4, 5, 6, 7, 8* (AA). — Near Chloride, May 13, 1931, *McKelvey 2196* (AA). — Between Hackberry and Peach Spring, May 6, 1932, *McKelvey 2744, 2745* (AA). — Just east of Peach Spring, May 12, 1931, *McKelvey 2167* (photo. 107-6) (AA: type). — East of Peach Spring, May 6, 1932, *McKelvey 2747* (AA). — Near the Peach Spring, north of town of same name, May 5, 1932, *McKelvey 2741, 2741A* (AA); same locality, Sept., 1932, (collected by *C. McGee*) *McKelvey 2898* (AA). — On road to New Water Point on Colorado River, April 29, 1934, *McKelvey 4085* (AA). Yavapai Co.: Congress and Hillside Station on the Santa Fe, Prescott and Phoenix R. R., flower larger than *Y. baccata*, height 0.5–1.0 m., 1902, *R. E. Kunze* (W). — Between Hot Springs Junction and Phoenix, April, 1929, (collected by *O. E. Hamilton*) *McKelvey 900E* (photos. 52-7, 8) (AA); March 28, 1930, *McKelvey 1645* (AA). — Bradshaw Mts., *G. Horderffer 18* (W). — Summit of grade on road from Phoenix to Prescott, Nov. 9, 1928, *A. Eastwood 16777* (CA). — South of town of Skull Valley, April 24, 1934, *McKelvey 4069* (photo. 143-4) (AA). — 4 miles west of Prescott, alt. 1700 m., April 24, 1934, *McKelvey 4062, 4063, 4065, 4066, 4067, 4068* (AA). — Prescott, Sept., 1911, *D. Griffiths* (M). — Among boulders, Prescott, Nov. 8, 1928, *A. Eastwood 16760* (CA). — Granite Dells, Prescott, June 2, 1929, *A. Eastwood 17678* (CA). — Granite Dells north of Prescott, May 6, 1932, *McKelvey 2748, 2748A, 2749* (AA); April 25, 1934, *McKelvey 4072* (AA). — Northwest of Prescott in Juniper Mts., April 26, 1934, *McKelvey 4076* (AA). — On road to Senator Mine from Prescott, *A. Eastwood* (CA). — Between Power House and Camp Verde, April 23, 1934, *McKelvey 4058A* (AA). — Fort Verde, April, 1888, *E. A. Mearns 337* (N); Copper Canyon west of Fort Verde, April 30, 1888, *E. A. Mearns 337* (N).

In discussing *Y. baccata* in typical form there have been many references to its variety; as here understood it is the prevailing form from the southeastern end of the Mohave Desert of California, across southwestern Nevada and extreme southwestern Utah, south and southeast into Arizona; in Arizona it has been found mainly in Mohave Co. south of the Colorado River and in Yavapai Co. but may extend as far southeast as the Roosevelt Dam region, or into northeastern Maricopa and western Gila Cos. Because in all this region, the extreme northwestern end of the range of *Y. baccata*, it largely, if not entirely, replaces the typical plant, it seems fitting to call it *Y. baccata* var. *vespertina*.

In certain areas, principally on the outskirts of this range, it is mingled with the typical form and intermediates are not uncommon; the extremes, however, are sufficiently distinct to deserve recognition.

Yucca baccata var. *vespertina* is distinguished by a dense, caespitose habit, forming small to often extremely large clumps with many short, more or less procumbent to erect stems and many confused and crowded heads of leaves, — the whole plant structure involved and somewhat untidy in appearance; the pale blue- or sage-green leaves are often twisted, falcate, or curved in various directions; in most districts the leaves are short but, on vigorous specimens and in certain regions especially, they are often extremely long; they are almost universally narrow, extremely concave (even as if folded lengthwise), and sharply angled in the center from base to apex; the fibres which separate along the margins of the blade while occasionally short, coarse and recurving as in the typical form are more often fine, curly to straight and rather long; the inflorescences are small, at times a foot, occasionally two feet in length overall, and soon ligneous; scape and rhachis are slender, the branchlets few and commonly short; bloom is inconspicuous, not only because mainly hidden in the foliage but because all parts (rhachis, bracts, flower-buds and even the outer surface of the expanded perianth) are as a rule deeply tinged with a dark reddish or brownish purple at anthesis; this color may even permeate to the inner surface of the corolla; on one specimen (*McKelvey* 2747) the coloring was nearly black and discolored several changes of preserving fluid; the inflorescence proper may be nearly racemose but for the most part is rather broad below and narrow above (the racemose tip exceeding the tops of the uppermost branchlets for some inches); in structure and form of flower parts the typical plant and the variety are very similar although on the latter abnormalities seem to be more common as is noted later; the variety may bloom slightly earlier; fruit is very similar in both.

Type of the variety is *McKelvey* 2167 (photo. 107-6), collected May 12, 1931, just east of Peach Spring, Mohave Co., Arizona; it is in the Arnold Arboretum herbarium. The altitude at the type locality was about 1600 m. and the plants grew in a rocky or mixed sand and gravel soil; while numerous and in fine flower they were not showy because the inflorescences (only 30-45 cm. in height) were set down among the leaves and were dark in color; the leaves were scabrous, very concave, even angled, in the center for their entire length, short, often twisted or falcate, with fine, curly marginal fibres of variable length; the clumps were dense with many heads of leaves; on the one shown in plate XIII, 25 were counted; some produced fewer heads, the majority even more. From the same or closely adjacent regions are *McKelvey* 2741, 2741A, 2744, 2745, 2747, 2898.

Plants of very similar appearance grew east and west of Kingman, around Valentine, south of Seligman in the Juniper Mts., between the Valentine region and New Water Point on the Colorado River. While found in the Pinyon and Juniper belt the variety does not seem to prefer the close proximity of these trees but often grows in full sun, even, as east of Kingman, being plentiful in the open desert; and while *Y. baccata* for the most part is more scattered and occasional, its variety grows in large stands with the clumps closely adjoining.

West of Kingman one group of plants (*McKelvey* 2738; 8 inflorescences) had more or less peculiar flowers, — the base, the pedicels, even the ovary warty or lumpy, and many were abnormal with corolla-segments and filaments often merged, too few or too many, etc. And two rather striking floral conditions were conspicuous on a number of these plants. First, the united, cup-shaped base (extending in species of this group above the base of the ovary) was often considerably prolonged as well below the ovary into a long-stipitate base; this was noted also in the following herbarium specimens: California, San Bernar-

dino Co.: *T. S. Brandegee*, Providence Mts.; *K. Brandegee*, Cima; Nevada, Clark Co.: *Kelly*, Bird Spring Range; Arizona, Mohave Co.: *Braem*, *Eastwood*, *Dudley* collections, Kingman region. Second, there was often no clear point of articulation between flower-base and pedicel, the two appearing as if fused and giving the effect of a long, funnel-shaped base to the flower; this was noted in the following herbarium specimens: California, San Bernardino Co.: *Munz*, *Johnston* and *Harwood* 4113, 4114, Providence Mts.; Nevada, Lincoln Co.: *V. Bailey* 1990, Quartz Spring; Clark Co.: *Coville* and *Funston* 310, 377, Charleston Mts.; Arizona, Yavapai Co.: *A. Eastwood* 16760, 17678, Prescott region; *M. E. Jones*, Hillside. Although these two conditions were not universal they were so common in regions where the writer considers that the variety of *Y. baccata* predominates that they might nearly be considered distinguishing characters; on the typical plant the cup-shaped base has not been found with more than, at most, a short-stipitate prolongation. From regions where typical form and variety intermingle the following herbarium specimens showed the long-stipitate base: Arizona, northwestern Coconino Co.: *A. Eastwood*, Grand Canyon, near the Powell Monument; *D. T. MacDougal* 50, Flagstaff region. Of the numerous specimens cited above some represent fruit and on such the long-stipitate base was even more conspicuous than on the flower; unfortunately specimens of fruit in the herbarium often lack the old flower-base.

A collection of flowers and leaves made by "J. G. Lemmon and wife" in Rucker Val [ley], Chiricahua Mts., [Cochise Co.], Arizona, September, 1881, is at the University of California (UC 367033, 367030); it seems probable that there was confusion in mounting this material for the following reasons. The Lemmons were in the vicinity of the Chiricahuas in 1881 as other collections testify. The two leaves (UC 367030) are clearly those of *Y. Schottii* which is common in these mountains and they undoubtedly came from there; the unusually well-pressed flowers (perhaps the work of the "and wife" of the label!) on both sheets are similar in size and form and show the elongated stipitate base and the lack of articulation between flower-base and pedicel just described; they belong, not, like *Y. Schottii*, to the *Treculeanae* but to the *Baccatae* series. The writer believes that these flowers must have formed part of another Lemmon collection (W 35847; UC 186581) made at Fort Mohave, Mohave Co., Arizona, April, 1884; for the peculiar floral structure, found in all, is so common on the variety *vespertina* that it seems more than probable that all came from this region which lies well within the range of that variety.¹ Of these Lemmon collections only the Fort Mohave sheets are cited, the rest of the material (excepting the leaves) is treated as of doubtful origin.

In certain regions, notably in the Acquarius Mts., Mohave Co., Arizona, between Burro Creek and the road leading to the Bagdad Mine, and still further southeast (or north and south of Hillside) the plants of the variety become extremely vigorous, the clumps very large, the stems rather elongated and the leaves often very long; flowering on these vigorous specimens was so rare that it seemed possible that they might represent a northwestern extension of either *Y. arizonica* or *Y. Thornberi* and bloom at a different season of year but old inflorescence-stalks were lacking. After several visits to these regions the writer came to the conclusion that the plants cannot be separated from *Y. baccata* var. *vespertina* and that, because of soil or other conditions, they are mainly vegetative or "run to leaf;" near Burro Creek they often grew in what appeared to be pure sand. In 1934 occasional inflorescences were found but not differing in any important particular from those of the variety of *Y. baccata*. The possible extension southward of this vigorous form is mentioned elsewhere. See p. 58.

¹ There is another specimen (PO 183483) the flowers of which appear in all respects identical with these other Lemmon collections; the sheet bears only the misdetermination "Y. Whipplei," and a Lemmon Herbarium label without date, collector or locality.

In Yavapai Co., about Prescott, Skull Valley, Kirkland, Piedmont and Congress Junction, further east on the divides between Jerome and Clarkdale, about Camp Verde and Power House, grew many intermediates difficult to classify as typical plant or variety; these regions mark the southeastern limits of the variety as here understood; it is possible that, from the last-named regions, the variety may extend southeastward into the mountainous country skirting the Roosevelt Dam in Gila and adjacent Maricopa Cos. where plant complexities are many. See p. 63.

YUCCA CONFINIS

Yucca confinis,¹ sp. nov.

Yucca baccata sensu Mearns in U. S. Nat. Museum Bull. 56, pt. I. 84, 85 (1907). Not *Y. baccata* Torrey.

Plant acaulescent, forming (at most) extremely short stems and few heads of leaves. Head of leaves constricted below, spreading above, with mostly erect-ascending leaves. Base of mature leaf about as broad as long, its median length approximately 6.5 cm., its breadth at insertion 6.5 cm., at union with blade 1.2–2 cm. Blade of mature leaf 0.60–.75 m. in length, contracted for 18–20.5 cm. above union with base, then rapidly broadened to near middle, thence tapered to apex, greatest width (flattened) 3.25–4.50 cm., (across concavity) 2–2.5 cm., straight, rarely incurved, symmetrical, rigid, near union with base (or where narrowed) plano-convex, elsewhere concavo-convex, smooth on both surfaces, dark blue- or yellow-green; leaf-margins separating above into short straight, below into long, loosely curled fibres; apex long-acuminate, with inrolled margins, its extreme tip circular, or flattened on upper surface; spine 0.7 cm. in length, slender, strong, acicular. Inflorescence 1–1.3 m. in length overall (scape 30–45 cm. in length, 2.5–4.0 cm. in diameter at base), flexuous; inflorescence proper much narrowed below (for lower half), broadened (and much same diameter) from middle to base of racemose tip, acuminate (racemose tip extending considerably above tops of uppermost branchlets), exceeding foliage for about $\frac{1}{2}$ its length, at anthesis well-filled to crowded, ligneous; for lower half flowers produced directly along rhachis, above (or where broadened) on short, erect-ascending branchlets; branchlets 15 or less in number, 5–18 cm. in length; flowers variable in size, 6.5–10.25 cm. in length, pendent, campanulate, often constricted at point where segments become free, expanding but little at anthesis, with base (united portion of perianth) somewhat unstable in form, commonly cup-shaped but occasionally gibbose (at times partially cup-shaped, partially gibbose in same flower), with broad-lanceolate, fleshy perianth-segments thickened in center especially near base and hood-shaped, fleshy-pubescent at apex; those of outer row broader near base and narrower near middle than those of inner row; filaments 3.25–4.0 cm. in length, united at base in short, collar-like band or occasionally (one or more, or all) independently attached in one flower, their major lower portion slender, short- to long-pubescent, their clavate tip $\frac{1}{6}$ – $\frac{1}{8}$ of entire filament in length, little broadened, at anthesis nearly erect to horizontal, pubescent to papillose; anthers 5 mm. or less in length, the basal lobes $\frac{1}{3}$ of entire length; pistil 5–6.3 cm. in length; ovary 4–5–6 times longer than broad 1–1.3 cm. in diameter near base), tapered to style, with 3 deeply cleft primary fissures and 3 intervening round-backed lobes indented slightly along lines of secondary fissures; style 5–7 mm. in length or shorter, about same in diameter, terminating at base in 3 short tips, at apex in 3 erect, short stigmas of variable length in same flower and short- or long-emarginate at apex; fruit (one only seen) large, 18 cm. in length, 5 cm. in diameter just above base, plump and

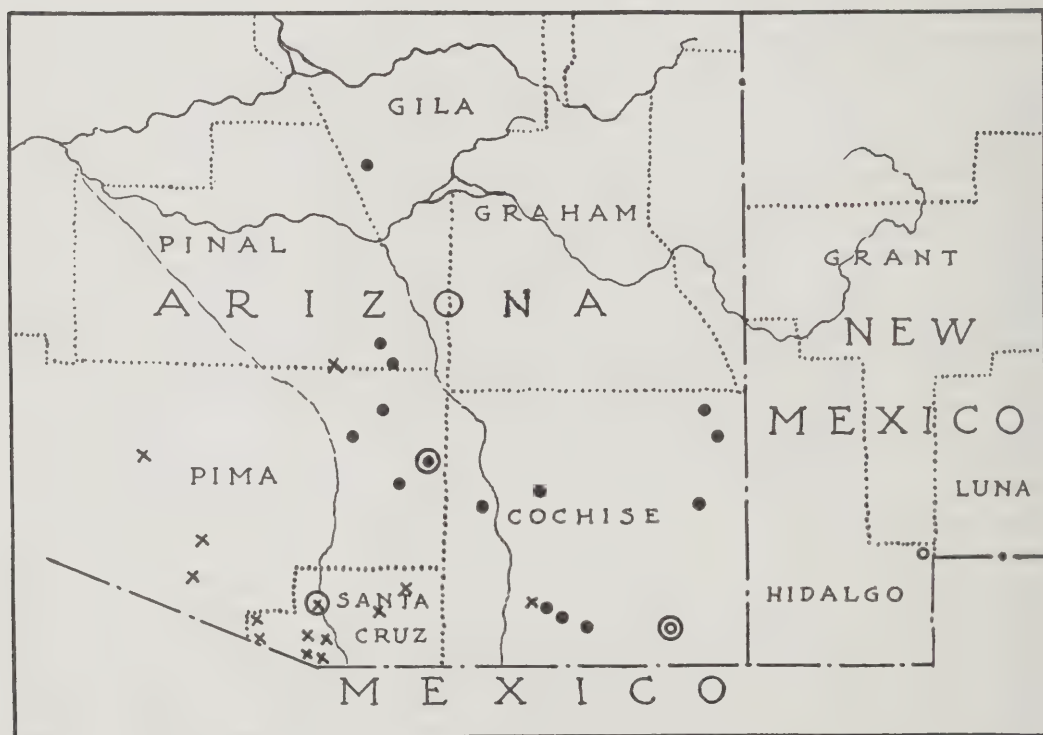
¹ Proxima *Y. baccatae* Torr., sed differt inflorescentia sub anthesi lignosa, scapo 30–45 cm. longo saepe flexuoso incluso circiter metrali, inflorescentiae ipsae dimidia parte superiore folia superante, basim versus angustata supra leviter dilatata apice acuta vel rotundata, foliis comam symmetricam ad basin constrictam supra latiore formantibus, lamina medio 2–2.5 cm. lata, stricta, ad marginem in fila satis longa tenuia dissoluta.

rounded for most of its length, for about 5 cm. below tip slightly contracted and asymmetrical; filaments in old floral base of this fruit variously attached (as in the flowers); two filaments abnormally long and adnate to body of fruit for most of their length.

Range. Extending from near Douglas in extreme southeastern Arizona, into the southwestern corner of New Mexico.

ARIZONA. Cochise Co.: On road from Rodeo to Douglas, about 14 or 15 miles northeast of the latter, el. ca. 4500 ft., among mesquite, May 3, 1931, *McKelvey 2099* (photo. 105-1) (AA; **type**); April 17, 1932, *McKelvey 2661, 2662, 2663, 2664, 2665* (AA). — Same locality, July 27, 1935, (collected by O. E. Hamilton) *McKelvey 4966* (photos. 169-1, 3, 4) (AA).

NEW MEXICO. Hidalgo Co.: "Upper Corner Monument, Grant Co.," May 11, 1892, E. A. Mearns 188 (S 52663) (N). — Monument no. 40, Mexican boundary line, May 9, 1892, E. A. Mearns 249 (W 560092).



MAP 3. Ranges of *YUCCA CONFINIS* (o), *YUCCA ARIZONICA* (X) and *YUCCA THORNBERI* (●).

In Cochise Co., Arizona, some 14 miles northeast of Douglas, along the road which leads from that city to Rodeo and Lordsburg, New Mexico, grows a colony of yuccas which twice has been seen in flower; in the summer of 1935 O. E. Hamilton procured for the writer a solitary specimen of fruit, the only one found after careful search, from the same group. The plants were more or less hidden among creosote-bush so that the size of the colony could not be estimated but it must have covered a considerable acreage of desert; the altitude of the region is about 1300 m.

On May 3, 1931, the plants were flowering plentifully, the flowers on the upper part of the inflorescence in perfect condition, those on the lower part over or going by; none were setting fruit, all flowers after anthesis withering and promptly falling. On April 17,

1932, they were in perfect bloom; careful search disclosed no yucca-moths although, from the condition of the flowers, they should have been present.

Although occasionally forming very short stems, for the most part the plants were stemless and grew in small open clumps with at most 3 or 4 heads of leaves. These were symmetrical, narrowed at the base, wide-spread above; the leaf-base, even on mature leaves, was small in proportion to the size of the blade and its breadth at insertion was about equal to its median length; the leaf-blade averaged about 0.65 m. in length but was often considerably longer; it was straight, rigid, very concave for most of its length, smooth on both surfaces, and many fine fibres were separating along its margins; its apex was long-acuminate, with inrolled margins and the terminal spine was extremely sharp, 3.2-7 mm. in length. The inflorescence was slender, long, 1-1.3 m. in length overall (the scape 30-40 cm. in length, 2.5-4.0 cm. in diameter at base), the rhachis flexuous, ligneous, very difficult to cut; the inflorescence proper was long, slender, extremely narrow for some distance above the base, slightly broader above, at extreme top acute; this form was explained by the fact that, along the narrow lower portion, the flowers were produced directly on the rhachis and, along the broader upper portion, upon a few short, erect-ascending branchlets (5-18 cm. in length) and, at the extremity, upon a racemose tip which exceeded by several inches the tops of the uppermost branchlets. The many flowers were pendent, 6.5-10.25 cm. in length, campanulate and considerably constricted just above the base (united portion of perianth); the pistil was long, 5-6.5 cm. in length at anthesis, with a long ovary which tapered from a stoutish base, 1-1.2 cm. in diameter, to the style; the style was short, with parallel sides, slightly longer than broad, and tipped with 3 erect, slightly thickened stigmas; the filaments were variable in length on different flowers, reaching from considerably below to about the base of the style; their lower portion was long, slender, their clavate tip about the same breadth as the lower portion, $\frac{1}{6}$ - $\frac{1}{8}$ of the entire filament in length and, at anthesis, turned at a near right angle to the lower portion, — consequently somewhat better defined than in other species of the series excepting *Y. baccata*.

These plants, while possessing the large campanulate flowers with long pistil found in all of the Baccatae series, showed certain floral instabilities which suggested *Y. Torreyi* of the Treculeanae series. The writer believes, after examining many specimens, that, in the Baccatae series the cup-shaped flower-base and the collar-like band in which the filaments are united, offer two dependable characters, — stable in the majority of specimens of an always more or less unstable genus. In the group of plants under discussion the base of the flower, while in most instances cup-shaped to short-obconical, was at times distinctly gibbose (as in *Y. Torreyi*) or, sometimes, half gibbose, half cup-shaped; and while the filaments were for the most part united in the collar-like band yet, in certain flowers only some were so united, others being free from those adjacent; again all might be separately attached.

The heads of leaves in form, and the leaf-blade in straightness, rigidity, long-tapering apex and short spine, suggested juvenile plants of *Y. Torreyi* and were not very different in appearance of vegetative parts from some of the plants found about Uvalde and Devil's River, Texas, where the ranges of *Y. Torreyi* and *Y. Treculeana* adjoin and where we find many confusing forms.

The inflorescence proper was somewhat similar in its ligneous character and in its form to that of *Y. arizonica* although it produced fewer branchlets (and these limited to the upper part of the rhachis rather than, as in *Y. arizonica*, produced along its entire length) and was buried for about $\frac{1}{2}$ - $\frac{2}{3}$ of its length in the foliage (in the Nogales plant it

is exerted for all or for most of its length); the common constriction of the perianth just above the base of the flower also suggested *Y. arizonica*.

While, for the reasons mentioned in the last three paragraphs, the plants of the Douglas region suggested the possibility of a strain of *Y. Torreyi* and *Y. arizonica* origin, yet their dwarf character suggested neither the arborescent Texan species nor the tall, shrub-like Arizona plant. *Yucca Torreyi* is not believed by the writer to extend far, if at all, west of the Rio Grande in New Mexico and is some 150 miles removed from the Douglas region; it might, in Mexico, extend further west and enter extreme southwestern New Mexico from the south, but this is purely hypothetical since herbaria contain no *Y. Torreyi* from this section. *Yucca arizonica* is believed to reach into the Bisbee region (not far west of Douglas) and may even spread so far east. Similar floral instabilities have been found in plants at Mountainair, New Mexico, and about Sanderson, Texas, which in other respects were clearly *Y. baccata* (see pp. 42, 43); while in each instance difficult to explain, these instabilities cannot be overlooked; nor can the Douglas plant (while in certain characters appearing intermediate to the Treculeanae and the Baccatae series) because of its dwarf habit and long pistil be identified with any but the last-named series.

The single fruit from the Douglas region (collected by O. E. Hamilton in 1935) showed the instabilities noted of the flowers, the filaments variously attached, some free from those adjacent, some overlapping or uniting; two filaments were abnormally attached, united for the greater part of their length to the body of the fruit and were also abnormally long.

Because of its proximity to the United States-Mexico line this species has been named *Yucca confinis*, or Yucca of the boundary. The type is *McKelvey 2099*, collected May 3, 1931, about 14 miles northeast of Douglas, Cochise Co., Arizona; the *McKelvey* photograph 105-3 (pl. XVI) is of this plant. From the same region are *McKelvey 2661*, *2662*, *2663*, *2664*, *2665* (April 17, 1932); also *McKelvey 4966* (O. E. Hamilton, July 27, 1935) with photographs 169-1, 3, 4 (pls. XVII, XVIII).

There are two E. A. Mearns collections (nos. 188, 249) identifiable with *Y. confinis*; no. 188 is found on 4 sheets of which two (W 560093) (S 52661) are labelled Carrizalillo Mts., New Mexico, April 14, 1892, two (N) (S 52663) Upper Corner Monument, Grant Co., New Mexico, May 11, 1892; no. 249 (W 560092) is labelled Monument no. 40, Mexican Boundary line, May 9, 1892. Although there are only two collecting numbers and two localities (the Upper Corner Monument and Monument no. 40 apparently the same) the dates indicate three collections. The expedition which Mearns accompanied (U. S. Nat. Museum Bull. 56: 83-85. 1907) made their Station no. 11 at Monument 40 which Mearns wrote as "in the midst of a tangle of hills known as the Apache Mountains . . . The only trees were a few red junipers. Vegetation was, however, more luxuriant than in the region to the eastward . . . Collections in nearly all of the departments usually covered were made at this place from April 22 to May 15, 1892 . . ." Mearns named *Y. baccata* among the "most abundant shrubs and conspicuous plants" of this region. This station accounts for *Mearns 249* and *188* (N) (S 52663). Station 10 was at Carrizalillo Springs, New Mexico, and Mearns wrote: "The neighboring Carrizalillo Mountains rise to an altitude of . . . 7,530 feet and their summits are sparsely covered with red juniper and smaller vegetation. At this camp the first important collection of plants was made . . ." April 15 to 22, 1892 is cited, and among "conspicuous plants" *Y. baccata*; this station (as far as locality is concerned) would seem to be the one where *Mearns 188* (W 560093) (S 52661) was collected, but it does not correspond as to date for the expedition was south of the boundary on April 14, Mearns writing (under

Station 9): "This dry camp was located a short distance south of the Boundary, and occupied from April 7 to 15, 1892, during which time collections were made in the immediate vicinity, though daily visits were made by either Mr. Holzner or myself to the neighboring Palomas Lakes, where most of the collecting was done . . ." These lakes are shown south of the boundary. The two sheets (W 560093) (S 52661) of April 14, do not synchronize (as to date or locality) with the data published by Mearns; the discrepancy is unimportant except for the fact that the range of *Y. confinis* (with which the *Y. baccata* of Mearns from this region is synonymous) would be extended a little further east. The flowers of all five sheets belong to the Baccatae series; leaves are only represented in nos. 248 and 188 (W 560093, one of the two sheets with doubtful label). The writer believes that the flowers, *in conjunction with* the foliage (suggestive of that of *Y. Torreyi*) can only represent *Y. confinis* and the Mearns specimens of satisfactory data are referred to this species. The reference on the labels of no. 188 (S 52663) (N) to Grant Co. is somewhat confusing as far as recent maps are concerned; when Mearns made his collections Monument 40 was situated where southwestern Luna Co. adjoined Grant Co.; with the subdivision of the latter into Grant and Hidalgo Cos. this southwest corner of Luna Co. seems to adjoin Hidalgo Co. instead.

YUCCA ARIZONICA

Yucca arizonica McKelvey in Jour. Arnold Arb. 16: 270 (1935).

Yucca puberula sensu Torrey in Botany, Emory Report, 221 (1859), in part. Not Haworth (1828). *Yucca brevifolia* Schott ex Torrey, Botany, Emory Report, 221 (1859), in part, as synonym of *Y. puberula*. — Engelmann in Trans. Acad. Sci. St. Louis, 3: 46 (1873), in part, as synonym of *Y. Schottii* Engelm. — Trelease in Rep. Missouri Bot. Gard. 13: 100, tt. 57, 58, 59, 96, fig. 2 (range map) (1902), first appearance as a valid species. Not *Y. brevifolia* Engelm. (1871). *Yucca Treleasei* MacBride in Contrib. Gray Herb. ser. 3, no. 56: 15 (1918). Not *Y. Treleasei* Sprenger.

Plants forming large, untidy, dense clumps, 1–2.5 m. or (with inflorescence) 2.8–3.6 m. in height, 4.5 or more m. in breadth, with about 25 stems and heads of leaves. Stem 1–2 m. in height, erect-ascending, rarely erect or procumbent, seldom branched, shaggy, covered with reflexed-spreading dead leaves to ground. Head of leaves overcrowded, confused, often flattened or saucer-shaped in the center of the top, 0.65–1.0 m. in length, 1–1.5 m. in breadth. Base of mature leaf longer than broad (rarely broader than long), its median length 5–9 cm., its breadth at insertion 4–7.5 cm., at union with blade 2–2.5 cm. Blade of mature leaf 0.30–0.60 m. in length, contracted for about 5–15 cm. above base (where 2–2.5 cm. in breadth), then broadened very slightly to about middle, thence tapered to apex, greatest width (flattened) 2.5–4 cm., rarely straight, commonly incurved, falcate, twisted, rigid to near middle, flexible above, thickened throughout except along margins of central portion, plano-convex to about middle, concavo-convex above, the outer convex surface somewhat angled in center for entire length, smooth on both surfaces, blue- or yellow-green (especially in center); leaf-margins thin, acute to sharp, separating early into fine, tough, nearly straight fibres 0.7–10–30 cm. in length, but eventually non-filiferous; apex acuminate; spine about 0.7 cm. in length, at first stiff, acicular, eventually blunt. Inflorescence 1–1.5 m. in length overall (scape about 45 cm., in length, 5 cm. in diameter at base), about 30 cm. in breadth at widest point; inflorescence proper elongated, slender, narrow below, more or less broadened above (rarely tapered at both ends), acute to rounded at apex (racemose tip 10–15 cm. in length, often with abortive branchlets near base, exceeding tips of uppermost branchlets by a few inches), surpassing foliage for 0.65–1.0 m. or for most of its length, at anthesis rather open, soon ligneous, glabrous, occasionally slightly glaucous, green or at first (rhachis, bracts, flower-buds) tinged with

reddish purple; branchlets about 35 in number (basal 10 cm. in length, central 20–22.5 cm., uppermost 10–15 cm.), erect-ascending, rarely spreading; pedicels 1.2–3.25 cm. in length, slender, at first erect, eventually spreading, rarely decurved; bracts on scape few; those above basal leaf-like ones 26–36 cm. in length, 2–2.5 cm. in breadth at insertion; uppermost bracts on scape about 15 cm. in length, 2.5–5 cm. in breadth at insertion, narrow-triangular with nearly straight sides or triangular-ovate, thin, fragile along margins, elsewhere in texture similar to a tough, thick paper, rather persistent, with acute to short-acuminate, spinescent apex; bracts at base of lower branchlets similar to those on upper scape, those at base of central and uppermost branchlets becoming gradually smaller in all proportions, slightly thinner and more fragile; bracts at base of pedicels 2.5–4.0 cm. in length, 0.7–1.0 cm. in breadth at insertion, narrow-triangular, thin, papery; flowers 6.5–13 cm. in length, globose to campanulate, with base (united portion of perianth) 0.7–1.0 cm. in length, slender-cup-shaped, with lanceolate, broad-lanceolate or occasionally oblanceolate perianth-segments similar in length in the two series and with hood-shaped, pubescent apex; segments of inner row 3–4 cm. in breadth, much narrowed and thickish below, elsewhere very thin, with irregular or fine- to coarse-denticulate margins which are occasionally pubescent near apex; those of outer row 2–3.25 cm. in breadth, thickened at base or for entire length in center, a little constricted and occasionally auricled at point where they become free, with entire or more or less denticulate margins, prominently veined on outer surface; filaments flaccid, 4–5 cm. in length, united at base in collar-like band 3.2–5 mm. in depth, their major lower portion plano-convex, densely fleshy-pubescent, their clavate tip $\frac{1}{6}$ – $\frac{1}{8}$ of entire filament in length, little swollen and erect to erect-ascending at anthesis; anthers 4.25–5 mm. in length, the basal lobes $\frac{1}{5}$ of entire length; pistil 4.5–7 cm. in length; ovary commonly 5–6 $\frac{1}{2}$ times longer than broad (rarely exceeding 8 mm. in diameter), tapered or fusiform, occasionally nearly oblong-cylindric with well-defined shoulders and tapered neck, often slightly curved or distorted, uneven to rough-surfaced, with 6 prominent fissures and 6 flat to rounded intervening lobes; style 5–7 mm. in length, about as broad as, or slightly narrower than long, terminating at base in 3 ill-defined tips, at apex in 3 short, nearly erect stigmas each about as broad at base as long and short- to long-emarginate; fruit more spreading than pendent, slender, long, 9–15 cm. in length, 2.5–4.0 cm. in diameter, oblong-cylindric or most often tapered for most of its length, for 1.2–2.5 cm. below tip gradually or abruptly contracted and soon drying, with primary and secondary fissures on swollen portion obliterated or reduced to broad shallow indentations, on contracted portion clearly apparent; epidermis smooth, glossy; perianth-segments and filaments long-persistent; pedicels more spreading than decurved.

For range map see p. 50.

Range. In Arizona extending from Santa Cruz Co. west and northwest into Pima Co., and east and northeast to the regions about Bisbee and Tombstone in Cochise Co.

ARIZONA. Santa Cruz Co.: 2–3 miles north of Nogales, Aug. 14, 1900, *W. Trelease* 409 (M). — Above Nogales, Aug. 15, 1900, *W. Trelease* 412 (2 sheets; M). — Northeast of Nogales, Aug. 15, 1900, *W. Trelease* 410 (M); Santa Cruz River near Nogales, Aug. 15, 1900, *W. Trelease* 411 (M). — Nogales, March 29, 1902, *W. Trelease* (M); March 30, 1902, *W. Trelease* (M). — Vicinity of Nogales, April 30, 1908, *J. N. Rose* 11935 (W). — Between Santa Cruz River and Nogales, June 18, 1929, *McKelvey* 1339 (photo. 34–3); March 15, 1930, *McKelvey* 1561; March 26, 1930, *McKelvey* 1643; May 6, 1931, *McKelvey* 2119, 2120 (photo. 106–2), 2121 (photo. 106–1), 2122; April 19, 1932, *McKelvey* 2677, 2678 (AA). — Hills near Santa Cruz River, July 25, 1935, (collected by O. E. Hamilton) *McKelvey* 4964 (photos. 167–4, 6), (AA). — South of Tucson, near International Boundary, April, 1905, *D. T. MacDougal* (N). — South of Sonoita, April 18, 1932, *McKelvey* 2673, 2674, 2675, 2676 (AA). — Just north of Patagonia, April 18, 1934, *McKelvey* 4047 (AA); July 22, 1935, (collected by O. E. Hamilton) *McKelvey* 4962 (photos. 166–1, 4, 5, 6) (AA). — Maloney's Mine near Sierra Pajarito, Aug. 13, 1900, *W. Trelease* 408 (M). — Ruby road in Pajarito Mts., March 25, 1930, *McKelvey* 1630 (photo. 78–9) (AA); March 26, 1930, *McKelvey* 1641 (AA). — "Valle de Tuback [= Tubac], VI. [June], VII. [July], 1855," *A. Schott* (M 135693; as to leaf; in part as to Schott sketch; type). Pima Co.: Baboquivari Mts., "Blue Yucca," April 3, 1926, *R. H. Peebles* 1592 (W; with note attached). — Fresnal, [Baboquivari Mts.], April 4, 1928,

F. A. Thackery 106 (W). — Quijotoa, "seeds smaller and leaves less filiferous than Trelease's description indicates," Aug. 9, 1931, *G. J. Harrison* and *T. H. Kearney* 8004, 8004A (W). — Devil's Canyon, [Ajo Mts.?], "Blue Yucca," April 30, 1926, *G. J. Harrison* 3972 (W). — Top of Comobabi Mts., Feb. 22, 1911, *J. C. Blumer* 4113 (M). Pima or Santa Cruz Co.: Between Tucson and Nogales, May 6, 1930, *R. H. Peebles* and *G. J. Harrison* 7035 (W). Pima or Pinal Co.: Tortoletos [= Tortillita Mts.], April 23, 1908, *J. N. Rose* 11897 (N). Cochise Co.: 28 miles northwest of Bisbee along road to Tombstone, April 18, 1932, *McKelvey* 2671, 2672 (AA).

Under *Yucca Schottii* have been discussed at length the collections (and their labels) made by Arthur Schott when working with the United States-Mexican Boundary Survey; Schott was assistant to Lieutenant N. Michler who was in charge of the western section. Schott's collections have long been accepted as an aggregate, — representing both *Y. Schottii* and the species under discussion which, since 1935, has been called *Y. arizonica*. The discussion is not repeated in full here; the reader should refer to *Y. Schottii*.

One sheet of Schott material, once in the Torrey Herbarium and reproduced (t. 57) and discussed in Trelease's monograph (1902), has not been located. The best of the material available at present is on a sheet in the Engelmann Herbarium (M 135693); the flowers and inflorescence parts of this sheet have been selected here as type of *Y. Schottii* and with them has been associated the Schott field-label (on the same sheet) citing the "Sierras oeste [= west] de S[an]ta Cruz" and dated July, 1855; this region is believed to be rendered more specific by association with the Schott field-label on the misplaced sheet which cites the "Sierra del Pajarito, near the monument;" the two monuments in the Pajarito Mts. which are mentioned in the Michler report are XIX and XVIII (new numbers 128 and 129 respectively) which are separated by only three miles; the writer has selected as type locality of *Y. Schottii* the country lying "near" or between them. The sketch attached to this sheet (M 135693) is discussed under *Y. Schottii*; it seems, like the material, to be an aggregate which can only be analysed hypothetically and is therefore of no importance.

On the same sheet is a leaf-blade, with base lacking; two apparently very similar leaves formed part of the misplaced sheet; this leaf-blade has been selected as type of *Y. arizonica* and with it has been associated the Schott field-label (on the same sheet) which reads at present: "VI.23.Liliaceae. *Yucca brevifolia* (mihi). (Satili) (Sonor). Valle de Tubac.VI.VII.1855.Schott." A different handwriting and ink indicate changes made by other than Schott; deleting these (VI.23 and the *parentheses about the word* Satili) it is apparent that Schott collected the yucca in June and July, 1855, in the valley of Tubac (the present spelling), that he had intended to call it *Y. brevifolia* and that it was the Datili of the Sonorans; the spelling on the label is clearly "Satili" which was obviously Schott's misunderstanding of the name by which the edible fruit of various yuccas is designated by the Mexicans. The type locality is the valley of Tubac, lying in the valley of the Santa Cruz River, Santa Cruz Co., Arizona. Michler's report indicates that he, and members of his section, must have passed through Tubac on more than one occasion so that Schott might well have been there twice, his label cites both June and July. *Yucca arizonica* blooms from mid-April to early May and Schott would have been too late for flowers or immature fruit (such a one formed part of the misplaced sheet and is associated for this and other reasons with *Y. Schottii* by the writer); the leaf in form, size and other characters conforms to those of *Y. arizonica*. Trelease (like the writer) identified only the foliage with Schott's *Y. brevifolia*. Tubac lies just off the present "main road" between Tucson and Nogales; at this time no yuccas grow immediately at Tubac (a "deserted village" even in Schott's day) but the writer has seen *Y. arizonica* slightly further south, on the low hills a little north of Nogales.

The history of the name of this species is as follows:

Torrey in 1859 cited Schott's manuscript name, *Y. brevifolia*, as a synonym of his *Y. puberula* Haworth; he did not note the complex represented in the Schott collection. Engelmann in 1873, although suspicious of the fact that the material might be an aggregate, associated the foliage with the flowers and noted that Schott "may have mixed the fruit of *Y. baccata* with the foliage of the new plant;" he cited *Y. brevifolia* Schott as a synonym of his new species *Y. Schottii*. The name *Y. puberula* Torrey, because of its connotation, is best cited under *Y. Schottii* the inflorescences of which are almost universally puberulous.

Trelease in 1902 took up Schott's name *Y. brevifolia*; by two visits to the region of Nogales he proved conclusively that Schott's collection was an aggregate; he wrote: "If, as now seems more probable than ever, the Torrey sheet of *Y. brevifolia* contains parts of two species, Schott's name may best apply to what Dr. Engelmann considered the most characteristic part, the leaves, particularly as the name *Schottii* has now become current for the remainder." (The writer does not agree with Dr. Trelease that Engelmann intended to separate the leaves and flowers of the Schott collection.)

In 1871 Engelmann had applied the name *Y. brevifolia* to the plant commonly known as the Joshua-tree. Trelease in 1902 when taking up Schott's name for the Nogales yucca, wrote: "The later *Y. brevifolia* Engelmann (1871) . . . is now proposed as the type of the genus *Clistoyucca* under its first published (varietal) name *arborescens*." In 1918, J. F. MacBride gave the Nogales plant a new name, *Y. Treleasei*, noting that "the plant to which the name *Y. brevifolia* Schott has been applied must receive another name because the cognomen has been given earlier to another (and valid) species."

Unfortunately MacBride's name had already been used for a hybrid yucca by Carl Sprenger. It appeared in his catalogues of 1901 and 1902 and was cited among a list of hybrids of "*Y. filamentosa* \times *rupestris*" in the *Bullettino* of the *Societa Toscana di Orticultura* of Florence in 1906 (p. 134); a few characters belonging to all plants of the same cross are given. Molon (Yucche, 192, t. VI. 1914) wrote more about the plant and published a colored plate showing leaf and inflorescence; he gave the parentage as "*Y. filamentosa* \times *rupestris* [*rupicola*]." Since MacBride's name was used earlier for another yucca the author in 1935 gave Schott's plant the new name *Yucca arizonica*.

Little has been written of this species; in August, 1900, and in April, 1902, Trelease made two attempts to collect the flowers; the plants did not bloom in 1900 and his second visit, he stated, was too early for flowers or fruit; his collections (foliage and seed) are represented on 7 sheets in the Missouri Botanical Garden; six sheets are from the Nogales region, one from the Pajarito Mts. J. N. Rose was the first to collect flowers, April 29, 1908; he wrote (Contrib. U. S. Nat. Herb. 13: 293, t. 48. 1911): "These are borne in large, erect, compound panicles, are white and hanging, and instead of being small as they are supposed to be, are very large;" his excellent plate shows a plant in full flower on the hills near Nogales, "not far from the type locality of the species." Flowers and a leaf collected by Rose near Nogales, April 30, 1908, are in Washington (W 454607).

When in flower on the low hills north and east of Nogales (in the region of the Santa Cruz River) it is extremely showy, the inflorescences raised high above the foliage (see pl. XXI) and noticeable from afar; the plants stand out as individuals and are so numerous and bloom so freely (17-20 inflorescences have been counted on one specimen) that the effect is magnificent; all seem to come into flower at the same time and after one week the best is over. Dr. J. J. Thornber (in litt., April 27, 1935) wrote: ". . . for a distance of 12 or 15 miles between Nogales and in the direction of Patagonia, there was one great mass of *Yucca* plants in blossom and one could count literally ten thousand flower clusters at

one time, and as far as I could see south, the whole country was dotted with these gorgeous clusters. I never had any idea before concerning the density of the growth of this *Yucca* . . ." In three successive years this region, which seems to represent the largest stand of *Y. arizonica* known at present, was visited by the writer; plants were in bud in late March, 1930; the first week of May, 1931, the best bloom was over; in mid-April, 1932, they were in perfect flower. On April 18, 1934, perhaps because of the severe drought, scarcely a flower had been produced in the region. In the three successive years when the plants had bloomed profusely not more than three or four fruits were found on any one plant; in 1929 a photograph was taken showing perhaps a dozen; in the summer of 1935 O. E. Hamilton was able to procure for the writer excellent pictures of this phase of the plant. In 1932 the flowers, about Nogales and also in the Pajarito Mts., were being devoured by a beetle and it was almost impossible to find a specimen with intact ovary and stamens; how much this insect may have had to do with the scarcity of fruit in other years is uncertain but in 1932 certainly it must have greatly reduced the number. The period of best bloom, while influenced by the coming of spring rains, seems to be about mid-April to early May.

The fact that *Y. arizonica* grows in separated colonies was noticeable in the Pajarito Mts. where the plant appeared and disappeared all day as the country was traversed; both here and about Nogales the plants grew in what was, superficially certainly, a very dry, baked soil of mixed sand and gravel; various oaks, mesquite, bear grass, sotol and *Agave Palmeri* were its associates; it ranged from 1050-1500 m.; *Y. Schottii* grew sparingly about Nogales but was more plentiful than *Y. arizonica* in the Pajarito Mts. and seemed to extend to higher elevations.

Standley (Contrib. U. S. Nat. Herb. 23: 93. 1920) suggested that *Y. arizonica* might extend into Mexico, stating ". . . doubtless in adjacent Sonora . . ." Dr. Thornber, in the letter already quoted, wrote that he was told that it extended ". . . into Mexico for at least 50 miles or farther, and that its growth was much denser in that country than in Arizona." Abrams 13211 (N) (S) places the species at Imuris, Sonora.

Up to now there has been no mention of an extension of range in Arizona beyond the Nogales region and the Pajaritos. The writer has found what seem to be isolated groups about Patagonia and about Sonoita, both in Santa Cruz Co.; also it occurs, intermittently rather than continuously, on the rolling country between Bisbee and Tombstone in Cochise Co.; perhaps it extends further east or beyond Bisbee but the writer is inclined to believe that *Y. confinis* or perhaps *Y. Thornberi* is mainly represented there.

How far west and northwest from the Pajaritos *Y. arizonica* occurs is uncertain. Among herbarium specimens are two which have been referred tentatively to this species; both bear the name "Blue Yucca;" one (Peebles 1592) is from the Baboquivari Mts., Pima Co.; it was determined by W. H. D. [?] as *Y. baccata* and a note states "South of the recognized range of this species. The identification is provisional and incorrect unless the plant is acaulescent from creeping rootstocks, and has blue-green coarsely filiferous leaves $3 \times 50-75$ cm.;" the second (Harrison 3972) is from Devil's Canyon; presumably, from the region where Harrison was working, this is the Canyon Diablo of the Ajo Mts., not the better known one of the same name in Coconino Co.; in the field the foliage of *Y. arizonica* is a blue-green and these specimens seem to represent a westward extension. From the same general region are: Thackery 106, from Fresnal, Baboquivari Mts.; Kearney and Harrison 8004, 8004A, from Quijotoa [lying between the mountains of that name and the Comobabi Mts.]; Blumer 4113, from the Comobabi Mts. [an extension northward of the Baboquivari Mts.]. Dr. Thornber, in the letter already quoted, wrote that Mr. Godding, connected with soil erosion work in southern Arizona, had called his attention to

the fact that in the Ruby country there was a yucca with long leaves ". . . as much as three feet in length, and . . . narrow . . ." The leaves of *Y. arizonica* are not always so short as those of the Schott collection but seem always to be narrow; it is probable that the plant is *Y. arizonica* although any determination must be guess-work. *Y. elata*, with leaves answering Mr. Godding's description, grows in the Ruby country. Nor is it impossible that *Y. baccata* var. *vespertina* (from the Date Creek region of Yavapai and Yuma Cos. much further north) should extend south into this region, the country seems propitious for such an extension.

The fact that *Y. arizonica* occurs along the "main road" from Nogales to Tucson has been mentioned in discussing the type; also that it has been found near Patagonia and Sonoita, — along the so-called "back road" between these cities; it seems probable that the species forms a part (whether major or minor is uncertain) of the many yuccas growing south and east of Vail in Pima Co. since it occurs no great distance south. *Y. Thornberi* extends south and east from the Rincon Mts. into this region. This stand of yuccas (about Vail) reaches nearly to Dragoon, Cochise Co. and herbarium material from this direction and beyond, even to the New Mexico border, has been identified by the writer with *Y. Thornberi*. Although often at Vail at the proper seasons for flowers and fruit she has never found either, and the plants may represent vegetative forms, for ecological reasons have "run to leaf." (This, in other regions, has seemed the only explanation for certain plants otherwise inseparable in one instance from *Y. baccata* var. *vespertina*, in another from *Y. Torreyi*.)

Many of the plants about Vail do not reach the dimensions of *Y. Thornberi* or of *Y. arizonica* either in size of plant or height of stem; one might expect an intermingling of these species here. Even north of Patagonia *Y. arizonica* seemed less stable in form of inflorescence, in size of flowers and in floral parts than it was about Nogales such a little way south; some of the plants were also smaller, with shorter stems. For some reason the inflorescences did not look entirely healthy or normal, but they were seen in 1934, the year of the drought (when there was no bloom about Nogales) and may merely have demonstrated the effect of adverse growing conditions.

See *Y. Thornberi* where the characters distinguishing that species, *Y. baccata* and *Y. arizonica* are discussed.

The writer believes that a considerably wider range in Arizona will eventually be attributed to *Y. arizonica*. *Rose 11897* from the Tortillita Mts. north of Tucson has been determined by her as that species; these mountains extend from Pima into Pinal Co. It may form a part, at least, of the many yuccas growing on the south slopes of the Pinal Mts. and over the mountainous country from Globe northwest to and about Roosevelt Dam. See p. 63.

YUCCA THORNBURI

***Yucca Thornberi* McKelvey in Jour. Arnold Arb. 16: 268, t. 138 (1935).**

Plants forming crowded, thicket-like clumps 2-5.5 m. in breadth, with 6-24 or more stems and heads of leaves. Stem 0.65-1.50 m. in length, covered to ground with dead, reflexed-spreading leaves, erect to erect-ascending, rarely procumbent, branched near or at 1.30-1.50 m. above ground. Head of leaves crowded, often confused, narrowed below, spreading above, at times considerably elongated, 0.30-1.30 m. in length, 0.50-1.30 m. in breadth. Base of mature leaf broader than long, its median length 2.5-7.5 cm., its breadth at insertion 7.5-13 cm., at union with blade 2.5-5.0 cm. Blade of mature leaf 0.3-1.0 or even 1.30 m. in length, tapered from union with base to apex or slightly broadened near

middle, greatest width (across concavity) 1.2–4.0 cm., straight or frequently curved outward, at times twisted, rather flexible, near union with base plano-convex, above concavo-convex, the outer convex surface somewhat angled near apex, smooth on both surfaces or occasionally slightly scabrous on outer surface near apex, yellow-green (young leaves blue-green, a little glaucous); leaf-margins at first acute, at times evanescently denticulate, entire (or without separating fibres), separating late into fine to coarse, loosely curled fibres 7.5–30.0 cm. in length; apex acuminate; spine stout, sharp, rather long. Inflorescence averaging 1.0–1.3 m. in length overall, at times even longer (scape 25–50 cm. in length, 2.5–5.0 cm. in diameter at base); inflorescence proper slender, slightly narrowed above and below, 20–30 cm. in breadth near middle, short-acuminate to acute (racemose tip about 15 cm. in length, surpassing tips of uppermost branchlets), exceeding foliage by $\frac{1}{4}$ – $\frac{1}{2}$ of its length, at anthesis well-filled but not crowded, fleshy, rather brittle, glabrous or slightly pubescent, yellow-green or at first (rhachis, bracts, flower-buds) more or less tinged with reddish purple; branchlets about 25 in number (basal 5–10 cm. in length, central 15–25 cm., uppermost 7.5–10.25 cm.), at first erect-ascending, central ones eventually spreading; pedicels 0.3–2.5 cm. in length, terete or somewhat flattened, occasionally slightly enlarged at union with flower; bracts on scape few (about 6 in number); those above basal leaf-like ones 20–28 cm. in length, about 4 cm. in breadth at insertion; uppermost bracts on scape 12.7–14.0 cm. in length, 5.0–6.5 cm. in breadth at insertion, lance-oblong to triangular-ovate, thick, fleshy (except along thinner margins), with short, slightly leafy or spinescent apex; bracts at base of lower branchlets similar to those on upper scape, those at base of central and uppermost branchlets becoming gradually smaller in all proportions till ultimately reduced to 5 cm. in length, 1.2 cm. in breadth at insertion or even less; bracts at base of pedicels similar in form to those at base of branchlets, 2.5–5 cm. in length, about 1.2 cm. in breadth at insertion, extremely thin, at times with slender median fold or thickening, fragile; flowers rather few in number (for size of inflorescence), large, 7.5–12.7 cm. in length, campanulate, not expanding fully at anthesis, with base (united portion of perianth) 0.7–1.0 cm. in length, rather slender, commonly short-stipitate below, with narrow- to broad-lanceolate perianth-segments more or less thickened in center (those of outer row for entire length, those of inner row near base), with thinner, uneven to finely and irregularly denticulate margins and hood-shaped, somewhat pubescent apex; segments similar in length in both series; those of outer row narrow, 2.25–3.20 cm. in breadth, those of inner row 3.2–4.0 cm. in breadth, except for basal thickening thin and fragile; filaments sturdy to flaccid, 4–5 cm. in length, united at base in collar-like band 3.2–7.0 mm. in depth, their lower portion fleshy-pubescent to papillose, their clavate tip $\frac{1}{5}$ – $\frac{1}{8}$ of entire filament in length, little swollen, nearly erect at anthesis, papillose; anthers 5 mm. in length, the basal lobes about $\frac{1}{3}$ of entire length; pistil 5.4–7.5 cm. in length; ovary $4\frac{1}{2}$ – $6\frac{1}{2}$ times as long as broad (8–10 mm. in diameter at widest point), commonly oblong-cylindric with well-defined shoulders and short, tapering neck, occasionally tapered from base to style, stout or slender, symmetrical, with 6 prominent fissures and intervening lobes; style 5–7 mm. in length, 3.2–5 mm. in diameter, coarsely papillose, terminating at base in 3 short, obtusish tips, at apex in 3 erect or occasionally spreading stigmas, broader at base than at apex, rarely equal in breadth below and above; fruit large, about 12–18 cm. in length, 3.2–4.5 cm. in diameter, tapered from base to apex, its major lower portion enlarged, its upper portion for 2.5–5.0 cm. below tip contracted, turned at a pronounced angle to lower portion and soon drying; fissures clearly indicated on contracted portion, on enlarged portion obscure, broadened into shallow indentations; exocarp smooth, often glossy; perianth-segments and filaments soon reflexed, persistent.

Range. Extending in southeastern Arizona from the Rincon and Santa Catalina Mts. north to the Pinal Mts., east to the San Simon Valley and the Chiricahua Mts., and southeast to the region about Bisbee. For range map see p. 50.

ARIZONA. Pima Co.: Mesas near Tucson, July 16, 1884, C. G. Pringle (P 70661; as to fleshy fruit only) — Pantano, Sept. 30, 1911, Griffiths (2 sheets; M). — Colossal Cave, [Rincon Mts.], May 6,

1930, *M. E. Jones 25969* (M) (PO). — Environs of Vail, March 18, 1930, *McKelvey 1570* (photo 75X-11); April 18, 1932, *McKelvey 2685-1, 2* (AA). — Rincon Mts., March, 1909, *D. T. MacDougal* (W). — Foothills of Rincon Mts., slightly north of Rincon Creek, a tributary of Pantano Wash, alt. 2000 m., March 19, 1930, *McKelvey 1585* (photo 75-7); March 23, 1930, *McKelvey 1627* (photos. 80-3, 4) (AA; **type**), *1628* (AA); May 8, 1931, *McKelvey 2123*; March 19, 1932, *McKelvey 2556, 2557, 2558, 2559, 2561, 2562*; April 19, 1932, *McKelvey 2682, 2684-1, 2, 3* (AA). — Santa Catalina Mts., from Lemmon Herbarium, no collector cited, Sept., 188- (PO). — Santa Catalina Mts., Sept., 1881, no collector cited (CA). Pinal Co.: Mt. Lemmon road above Oracle, Santa Catalina Mts., July 19, 1935, (collected by *O. E. Hamilton*) *McKelvey 4961* (photos. 165-9, 10, 11), *4961A* (photo. 165-7) (AA). — Santa Catalina Mts., April 20, 1930, *G. I. Harrison* and *T. H. Kearney 6687* (W). — Near Oracle, [Santa Catalina Mts.], *G. I. Harrison* and *T. H. Kearney 6687* (PO). Gila Co.: In Pinal Mts., near top of divide on road from Winkleman to Globe, alt. 1500 m., May 9, 1931, *McKelvey 2125, 2126, 2127* (AA). Cochise Co.: Benson, April 6, 1930, *M. E. Jones 25918* (M) (PO 178408; excluding flower of series *Faxonianae*). — Vicinity of Benson, March 2, 1910, *J. N. Rose, P. C. Standley* and *P. G. Russell 12330* (N). — Dragoon, April 14, 1931, *M. E. Jones 28399* (PO) (UC) (M). — San Simon, April 15, 1931, *M. E. Jones 28403* (M; excluding flowers of capsular species) (S) (PO) (UC). — San Simon Valley, April 21, 1894, *W. W. Price* (S). — Ramsey Canyon, [Chiricahua Mts.], April 6, 1930, *M. E. Jones 25917* (PO 178409; excluding flower of series *Faxonianae*); *M. E. Jones 28917* [= probably 25917 since series 28000 = collections of 1931] (PO 178407). — East slope of Mule Mts., east of Bisbee, April 18, 1932, *McKelvey 2666, 2667* (AA). — 13 miles northwest of Bisbee, April 18, 1932, *McKelvey 4040, 4041* (AA). — 27 miles northwest of Bisbee, April 18, 1932, *McKelvey 2669* (AA).

Yucca Thornberi was first described by the writer in 1935; the type locality is the "Foothills of the Rincon Mts., slightly north of Rincon Creek, a tributary of Pantano Wash," Pima Co., Arizona; the type is *McKelvey 1627*, March 23, 1930; *McKelvey 1585, 2123, 2556, 2558, 2559, 2561, 2562, 2682, 2684* are from the same locality; all are in the Arnold Arboretum herbarium; photographs 80-3, 4 (see pl. XXVI) are of the type plant, 75-7 of *McKelvey 1585* (pl. XXV); from the Vail region south of Pantano Wash is *McKelvey 1570*, photograph 75x-11 (pl. XXVII). The name was chosen in recognition of the fact that Dr. J. J. Thornber of the University of Arizona called the writer's attention to the plant and with her spent some time in its study.

The elevation at the type locality is about 1000 m. and the plants were scattered over an area of considerable extent; it is distinctly a desert region (the soil mixed sand and gravel), abounding in opuntias, barrel-cactus, sotol, creosote-bush and mesquite; *Y. elata* too forms handsome specimens here.

The possibility that *Y. baccata* (found in typical form in the Pinal Mts., Pinal Co., and in the Mazatzal Range and Sierra Ancha, Gila Co.) might be represented here by a southern form of more vigorous, taller habit, was considered since its flowers are very similar; but the two species differ greatly in habit of growth, in form of inflorescence, in foliage and, to a lesser degree, in fruit; also, the flowering season of *Y. Thornberi* is considerably earlier in Arizona even allowing for differences in latitude and altitude.

Yucca Thornberi forms large, many-stemmed clumps, taller than even the most vigorous forms of *Y. baccata* var. *vespertina*; its heads of foliage are broadest near the top, those of typical *Y. baccata* near the base; its leaves are longer and narrower than in that species, with somewhat longer spine and often smoother surfaces, and the marginal leaf-fibres are finer and separate late rather than early. The inflorescences in both are fleshy, heavy, with broad-triangular, large, thick, fleshy to leathery, bracts; that of *Y. Thornberi* is long, at times 1.5 m. overall (the scape about 0.5 m. in length), slender, narrowed both above and below, often exceeding the foliage for $\frac{1}{2}$ its flowering portion; its branchlets number about 25, the lowest and uppermost short, erect-ascending, the central rather long, only eventually spreading-ascending; the racemose tip extends considerably above the tops of the uppermost branchlets; the inflorescence of *Y. baccata* rarely exceeds 0.75 m. in length overall (the scape about 10-15 cm. in length), broad, narrowed below and much

broadened above, scarcely exceeding the foliage; its branchlets number about 15, the lowest erect-ascending, those above spreading-ascending; the racemose tip scarcely extends above the tops of the uppermost branchlets. The flowers in both species, while generally very large, vary in size, and from campanulate to somewhat globose in form; the ovary in *Y. Thornberi* is mostly symmetrical and oblong-cylindric, less often tapered from base to style; that of *Y. baccata* is characteristically lop-sided, commonly tapered upward from the base. In both species the fruit is long, averaging about 18 cm. in length; that of *Y. Thornberi* appears the more slender although only slightly less in diameter, — averaging 4.5 cm. as against 6.5 cm. in *Y. baccata*; its upper portion (for 5–7.5 cm. below the tip) is abruptly contracted into a slender, often recurving tip; frequently lacking in *Y. baccata* this tip, when present, is commonly straight.

Yucca arizonica approaches the Rincon Mts. from the south. This species is also separable from *Y. Thornberi* in form of leaf-cluster and in form and character of inflorescence (and bracts), in foliage and, to a lesser extent, in fruit; in habit of plant and in flowers the two are very similar; also, *Y. Thornberi*, although growing slightly further north, seems to bloom, with regularity, about two weeks earlier than the Nogales plant; the elevations of the two regions are much the same although the vegetation of the Rincons is of a distinctly desert character while about Nogales there is more grass-land and trees, such as *Quercus Emoryi*, are abundant. The stem in *Y. Thornberi* averages a little shorter than that of *Y. arizonica* and the plants are slightly less confused and untidy in appearance, with on the whole fewer and more symmetrical heads of leaves; in *Y. arizonica* these heads have a curious tendency to flatten out in the center, appearing at that point rather saucer-shaped (see pls. XXII, XXIII); the leaves of *Y. Thornberi* are mostly yellow-green (in *Y. arizonica* a bluer green), more concave, longer, broader, often straighter, with longer spine and the fibres along the leaf-margins separate late, — the blade is therefore non-filiferous when young, filiferous when mature; the marginal fibres separate early in *Y. arizonica*, — the blade is therefore filiferous when young, non-filiferous when mature. The inflorescence of *Y. Thornberi* is fleshy, that of *Y. arizonica* soon ligneous, with more branchlets (about 35) and more flowers than the plant of the Rincon Mts.; while in both species it is long and slender, in *Y. Thornberi* it is tapered at both ends, in *Y. arizonica* tapered below and commonly broadened above; in *Y. Thornberi* (and in *Y. baccata*) the bracts of the inflorescence are thick, fleshy to leathery, broad-triangular, while in *Y. arizonica* they seem to be of a more tough-papery texture and narrow-triangular (the margins are therefore straighter); on only one specimen from the Rincon Mts. (McKelvey 2562) the bracts were somewhat similar to those of the Nogales plant in form. The flowers of both species are commonly large but, rarely, quite small; in those of *Y. Thornberi* the perianth segments are less often constricted above the base of the flower (united portion of perianth) than they are in *Y. arizonica* (and in *Y. baccata*), and the ovary is perhaps stouter. The fruit of *Y. Thornberi* averages a trifle longer and a little more (0.7–1.2 cm.) in diameter and the tip is commonly recurved while that of *Y. arizonica* is commonly straight; of the three species just compared the fruit of *Y. baccata* is stoutest at maturity, that of *Y. Thornberi* intermediate, that of *Y. arizonica* the slenderest and, for a time certainly, more angled in contour.

The writer has been many times to the type locality. The third week in March, 1930, plants were in perfect flower. May 8, 1931, they were in fruit although on hundreds of plants, perhaps only a dozen were found; a few of the black beetles, which in the Nogales region devour the ovary of the flower, were seen and may have been in part responsible; on all fruits the perianth and filaments had reflexed. On March 19, 21, 1932, plants were in bud, promising fine bloom in about 10 days. On April 21, 1934 (a year of

extreme drought), there was no sign of flowers, indeed, except for a few composites, nothing was in bloom in the region.

About Vail, south of Pantano Wash, flowers were collected (and photographed) March 18, 1930, again April 19, 1932. From this region plants stretch for a way westward, towards Tucson. Whether all which radiate south and east represent this species — some may be *Y. arizonica* — has not been determined for they have never been found in flower and their separation, on foliage alone, has not been attempted. Toumey wrote that *Y. baccata* covered "large areas on the east slope of the Chiricahua Mts. between Gaylord and Fort Bowie . . ." His plant must have been either *Y. Thornberi* or *Y. arizonica*, probably the former.

On April 17, 1932, flowers were collected on the east slope of the Mule Mts. not far from Bisbee, which seemed to be this species; the next day, about 30 miles northeast of Nogales both *Y. Thornberi* and *Y. arizonica* were found; yuccas of this group are innumerable here; as the plants of the region were examined the flowers seemed to average smaller on those of *Y. arizonica* (the leaves blue-green, the inflorescence of characteristic form) than on those of *Y. Thornberi* (the leaves yellow-green, the inflorescence fleshy, few-flowered). On April 18, 1934, 13 miles northwest of Bisbee, only two of the many plants were in flower; on both the inflorescences were nearly ellipsoidal, fleshy as in *Y. Thornberi*; the flowers of one (*McKelvey 4041*) were almost a pale yellow, of the other cream.

Except for the localities cited (which show a trend southeastward from the type locality) the writer has only collected *Y. Thornberi* on the top of the divide (about 1500 m.) in the Pinal Mts., Gila Co.; here some flowers were extremely large, exceeding 12.75 cm., others were about 7.5 cm. in length; the plants formed stems 1 m. or more in height. It is believed that *Y. baccata* also grows in these mountains; their southern slopes are covered with many yuccas, of this group undoubtedly, but they have never been found in flower or in fruit, nor have old inflorescences remained. The possibility that *Y. Thornberi* extends into the mountains southeast, west and northeast of Roosevelt Dam is discussed at the end of this species.

The first collection of *Y. Thornberi* (leaves only) seems to have been made by Dr. D. T. MacDougal, March, 1909, in the Rincon Mts.; Griffiths collected it at Pantano and M. E. Jones at Colossal Cave which is only a short distance east of the type locality and in the same mountains. E. B. Bartram (*Bull. Torr. Bot. Club*, 49: 242. 1922) wrote of "thickets [of *Y. baccata*] in the mouth of Sabino Canyon [on the south side of the Santa Catalina Mts.]. Apparently washed down from the higher levels;" the reference is to *Y. Thornberi*. *Harrison and Kearney 6687* from the Santa Catalina Mts. (one sheet specifies Oracle) extends the range considerably further north into Pinal Co.; from here the distance is not great to the Pinal Mts. where the writer collected it. Dr. J. J. Thornber wrote (in litt., May 28, 1935): ". . . a week ago last Saturday while going up the [?] road in the Santa Catalina mountains, I found the most marvellous specimens of *Yucca Thornberi* that I have ever seen. Some of these clumps of plants were 20 or 30 feet across and the stems anywhere from three to five feet in height, and the flower clusters as many as fifty or more to a clump. They were in perfect condition that Saturday for photographing. However, as usual, I did not have my camera with me. . ." In July, 1935, O. E. Hamilton went into the Catalinas and obtained fruit and photographs; he found, on the "Mt. Lemmon road," no plants of such large size but Dr. Thornber may have been on a different road. From east and southeast of the Rincon Mts. herbarium material indicates the following stations in Cochise Co.: Benson (*M. E. Jones*, 1930; *Rose, Standley and Russell*, 1910); Dragoon (*Jones*, 1931); San Simon and San Simon Valley (*Jones*, 1931; *Price*, 1894);

Jones also collected it in the Chiricahua Mts. in 1930; this collection includes some flowers of *Y. Faxoniana*, from the Sierra Blanca region, Texas.

* * * * *

It may be well to mention here some of the complexities existing in parts of Arizona where some members of the Baccatae series appear to intermingle. The flowers of all four species of the group are very similar but marked differences of habit, of inflorescence and, to a lesser degree, of foliage distinguish them. Throughout some three-fourths of the state of Arizona these yuccas abound, — only desert areas (such as extend for example over parts of Yuma, Maricopa and Pima Cos. to the south and southeast, of Navajo and Apache Cos. to the northeast, and of northern Coconino and Mohave Cos. to the north) appearing in the main inimical and given over to capsular species. The literature and determinations in herbaria indicate that plants of the Baccatae series when from the Nogales region have been classified as *Y. Treleasei* MacBride (= *Y. arizonica*), when from any other region in the state as *Y. baccata* or as "*Y. macrocarpa*¹;" the writer has not found determination as simple as this. Two regions in particular require much further field work before the yuccas growing in them are understood.

One is that part of southeastern Arizona lying east of an imaginary line drawn between the Rincon Mts., on the north and Nogales on the south, for into it *Y. Thornberi* (with type locality in the Rincon Mts.) and *Y. arizonica* (with type locality in the Santa Cruz River valley) both appear to extend; yuccas of this group abound in this region; how many are of a pure strain, how many represent the results of intermingling (for this *must* have occurred) is by no means clear to the writer; many, as has been noted, seem to bloom but rarely if at all. Nor does the problem clear up at the New Mexican line; rather it becomes more complicated for to the south *Y. confinis* (with type locality to the north of Douglas) and to the north *Y. baccata* (growing plentifully about and south of the Silver City region) both enter the picture. That it offers difficulties is not surprising for, in a small area — comparatively — grow four species each of which, even when most clearly defined, is extremely variable (in large part because of the facility with which crossing occurs within its own membership) and all of which are closely related and presumably adapted, therefore, to true hybridization.

The second region lies in southeastern and westcentral Gila Co. and includes the Pinal Mts. south of Globe, the mountainous country extending from near that city to and about the Roosevelt Dam, as well as the Mazatzal Range to the west of and the Sierra Ancha to the northeast of the Dam. The yuccas, all belonging to the Baccatae series, which cover these mountain slopes and extend into their many canyons are innumerable; while, looked at casually, all appear very similar, upon study they offer many complexities; all up to now have been determined as *Y. baccata*. That species undoubtedly enters the region; it seems to occur (or certainly seems to be more readily recognizable) at the higher altitudes (1300 m. and upward); it is not common in typical form. Its variety *vespertina* may come in from the west, north and northwest (it mingles with the typical plant about Prescott and Skull Valley and in the Jerome-Clarkdale-Camp Verde regions of Yavapai Co. not far away); on the whole most of the plants of the Roosevelt region are more suggestive of this form in general appearance than of the typical plant. The writer believes that *Y. Thornberi* grows at the top of the divide in the Pinal Mts. and it would be strange if it stopped at this point, indeed there are indications that it does not. While

¹ "*Y. macrocarpa*," without citation of author, was often applied to plants of *Y. Schottii* Engelm. (first named *Y. macrocarpa* Engelm.); this species grows in southeastern Arizona but is not to be mistaken for any member of the Baccatae series; in the herbarium, however, one occasionally finds the name misapplied to plants of this group.

there exists a wide territory between the range of *Y. arizonica* as known at present and the Roosevelt country (and one where this species has not been recognized) yet, in the Mazatzal Range grow many plants which definitely suggest that species. On the outskirts of their ranges plants may change somewhat in appearance, from north to south becoming taller or the reverse; the Roosevelt region might well represent changes of this character; crossing within one species and hybridization, should several species intermingle, would add to instability. Some plants seem to bloom earlier than others in the region but how much bearing a protected or open situation, a northern or southern slope, a higher or lower elevation, a drier or moister soil (and all these factors enter the picture here) has had upon this would have to be taken into account. For all these reasons, and since yuccas do not flower to order, no determinations of any value can be made except after an intensive and probably a prolonged study. The writer cannot believe that any of the plants mentioned below represent a pure strain; nor is she convinced that most of the many plants growing about Roosevelt are sufficiently stable to warrant specific recognition.

While the writer has some data (specimens, photographs, notes) corroborating this belief, little would be gained by discussing these plants at the present time. Some of her collections from the region are not included in the citation of specimens but are listed below. Miss Alice Eastwood traveled with the writer in 1929 and yucca collections were often divided; by comparison it has been possible to associate the two collections (here and in the citation of specimens); the writer's are sometimes associated with photographs and some are more comprehensive. These collections are mainly from the Mazatzal Range, along roads leading to the Amethyst Mine and the Sunflower Mine (which Miss Eastwood cites as Mercury Mine). They are: Road to Sunflower Mine, May 6, 1929, *McKelvey* 930,931 (photo. 7-12; pl. XXIX) (AA). — Road to Mercury Mine, May 6, 1929, *Eastwood* 16925 (G) (CA; flowers similar to *McKelvey* 931; fruit similar to *McKelvey* 1144). — Road to Amethyst Mine, May 11, 1929, *McKelvey* 986 (AA). — Road to Sunflower Mine, May 15, 1929, *McKelvey* 1040 (photo. 15-3; pl. XXX) (AA). — "Between Roosevelt and Globe, 1929," Eastwood (CA; similar to *McKelvey* 1040). — Road to Sunflower Mine, May 26, 1929, *McKelvey* 1144 (AA). — Between Roosevelt and Globe, May 10, 1931, *McKelvey* 2142 (photo. 106-9) (AA). — Same locality and date, *McKelvey* 2142A (photos. 106-12, 107-3) (AA).

SERIES 3. TRECULEANAE, SER. NOV.

Pistillum breve, 2–3.25 cm. longum, tantum in *Y. Torreyi* ad 4 cm. longum.

All species of this series are arborescent when fully developed. Their flowers are distinguished from those of the Baccatae and the Faxonianae series by a much shorter pistil which only in *Y. Torreyi* (and in that species only rarely) reaches 4 cm. in length, by shorter, mostly more sturdy filaments with, proportionately to the whole, a longer and better-defined (since more swollen and at anthesis held at a conspicuous angle to the lower portion) clavate tip,¹ and by a gibbose, flattish or saucer-shaped base (united portion of perianth) scarcely reaching, if at all, above the base of the ovary; also, in all members of this group, the filaments are adnate only at the very base of the perianth rather than from its base to a point considerably above the base of the ovary as in the Baccatae and Faxonianae series. This attachment is not the same in all species of the group and may vary in one species but one manner of attachment *predominates* in each species; in *Y. Treculeana* the filaments are considerably broadened at base and for the most part just touch or overlap; in *Y. Torreyi* each is free from those adjacent, often overlapping but rarely touching; in both *Y. Schottii* and *Y. schidigera* the broadened bases commonly unite but their union is irregular in form, depth and thickness and does not suggest the flat, collar-like band found in the flowers of the Baccatae; the manner of attachment is, in this group especially, easier to see in the fruit than in the flower for the filaments are then enlarged near the base and, when the perianth has become reflexed, exposed to view.

In the United States *Y. Treculeana* is practically confined to southcentral Texas. *Y. Torreyi* occurs mainly in southwestern Texas but extends into adjacent southeastern New Mexico. In the region of Uvalde Co., Texas, the western limits of *Y. Treculeana* interlock with the eastern limits of *Y. Torreyi* and the confusing plants growing in this section appear to be the result of this intermingling. *Yucca Schottii* occurs principally in southeastern Arizona but crosses into the mountains of extreme southwestern New Mexico; its season of bloom, July and August, is much later than that of the three other species which flower in the late winter or early spring; indeed it blooms later than any other yucca with baccate fruit; the fact that its flowers are uniformly small may perhaps be explained by the fact that they come so late in an extremely hot part of the country. *Yucca schidigera* is largely a Southern-Californian species although in the Mohave Desert region it crosses into northwestern Arizona and southern Nevada. *Yucca Treculeana*, *Y. Torreyi* and *Y. Schottii* extend south into Mexico and are said to reach a finer development there; *Y. schidigera* also extends into Mexico in the region of Lower California.

Yucca Treculeana for the greater part of its range grows in the chaparral but along the Gulf of Mexico is found on open flats close to the sea. *Yucca Torreyi* and *Y. schidigera* grow mainly in the open desert, extending thence into the foothills of adjacent mountains. *Yucca Schottii* is found for the most part in mountain ravines, often in the shelter of trees; from these surroundings it spreads into more open and lower country; it probably mounts to higher elevations than any other member of the group. *Yucca schidigera* and *Y. Treculeana* are both found at sea-level, the first along the Pacific, the last along the Gulf; inland *Y. schidigera* reaches higher elevations than *Y. Treculeana*.

That *Y. schidigera* and *Y. Torreyi* were the same species was long believed; even as recently as 1902 Trelease wrote: "Though the principal difference between this [*Y. schidi-*

¹ Although longer and larger the filaments in *Y. baccata* and *Y. confinis* somewhat resemble in form those found in the Treculeanae series.

gera] and the preceding [*Y. Torreyi*] lies in the style, which is contracted and short in the one and elongated in the other, the great area of desert country lying between their respective localities makes it desirable to recognize them as distinct species." Munz and Johnston (Bull. Torr. Bot. Club, 49: 34, 1922) wrote that the style characters of Trelease and the flower and fruit characters of Sargent "seem to be illusionary" and felt that the distinctness of the two species was open to doubt. It may be well to comment here upon some of the points of similarity and dissimilarity existing, not only between these two plants, but between all members of this group.

No distinctions in the habit of the four plants holds good universally; all are handsomer and more symmetrical when juvenile than when old and weatherbeaten; in the writer's mind, however, the impression persists that plants of *Y. Treculeana* and *Y. Schottii* are of a more pleasing, finer (that is less coarse) appearance than plants of *Y. Torreyi* and *Y. schidigera*; the smoother appearing leaf-blade without detaching fibres found in the two first may be in part responsible. *Yucca schidigera* and *Y. Schottii* commonly produce several stems and, in the last, one stem is apt to incline outward from the base; *Y. Torreyi* and *Y. Treculeana* as a rule are single-stemmed and average taller than the other members of the group; when the leaves have fallen from the trunk of *Y. Treculeana* it looks over slender for the size of the plant. The heads of leaves in *Y. Torreyi* are elongated, longer than broad and spread near the top, in the other three species they are broader than long; those of *Y. Treculeana* and *Y. Schottii* are broadest near the base, of *Y. schidigera* near the middle or above; exceptions can of course be found. In the fleshy-fruited yuccas the leaves are always a blue-green and paler when young than when mature; those of *Y. Schottii* seem in the main to retain this color and a rather pale tone for the lifetime of the plant, with age sometimes, and with drying characteristically, assuming shades of lavender; those of *Y. Treculeana* remain mostly a blue-green but become darker eventually; at maturity those of *Y. Torreyi* and *Y. schidigera* become a dark yellow- or olive-green; it has been written that the last-named produces in one part of its range a strain with blue-green foliage. The inflorescence of *Y. Schottii* is characteristically puberulous, glabrous forms extremely rare; the reverse is the case in the other three species, in fact the writer has never found the structural part of the inflorescence pubescent throughout in any of these; in *Y. Schottii* the inflorescence seems to be smaller, fewer-flowered and fewer-branched and as a rule, because of its very short scape, is set lower among the leaves than are those of the other three species. In the inflorescences of all we find a tendency to a narrow base and broadened top; *Y. Treculeana* produces a variety with nearly ellipsoidal inflorescence, slender also in proportion to length. In all four species we find small, globose flowers; *Y. Schottii* appears to produce no other form; only very rarely are large, more campanulate flowers found on *Y. schidigera* (McKelvey photos. 83-2, 7); *Y. Treculeana* produces a large-flowered variety which is confined to a limited portion of its range; large flowers, the predominating form, have been considered here as typical of *Y. Torreyi* and the not uncommon, small flowers of its form. The attachment of filaments characteristic of each species has been mentioned; these organs, in proportion to the size of the pistil, seem larger in *Y. Treculeana* than in others of the group; the clavate tip proportionately to the entire filament seems longer in *Y. Torreyi* than in the other three species where it is short and stout. In all the pistil is small. In *Y. Torreyi* it is occasionally longer than in the others and its form at anthesis is distinct, — the ovary tapering from base to style, style and stigma (treated as a unit) vase-shaped, spreading from union with the ovary to the tips of the three stigmas; *Y. Treculeana* has a slender, oblong-cylindric ovary, a short, slender style above which the stigmas spread abruptly at anthesis; *Y. Schottii* has a very similar ovary and style but the stigmas are erect; *Y. schidigera* has an ovary of much the

same length as that of *Y. Treculeana* and *Y. Schottii* but it is always stouter and, while occasionally oblong-cylindric, it is characteristically tapered and its stigmas are erect. The fruit of *Y. Torreyi* approaches in size and form that found in the *Baccatae* series; it is longer and greater in diameter than that of any other species of the *Treculeanae* series; the fruit of *Y. schidigera* and *Y. Schottii* is characteristically plump, variously constricted and distorted; that of *Y. Treculeana* is rather slender and as a rule symmetrical.

In studying the members of this group one is impressed by occasional similarities between them, also by the considerable variation and instability within each species; speculation is aroused as to their origin. The fact that certain characters now seem to predominate in plants of a definite range (the four yuccas of this group are rather widely separated from each other, only the range limits of *Y. Torreyi* and *Y. Treculeana* adjoining in a limited region) seems to warrant their separation as species.

YUCCA TRECULEANA

Yucca Treculeana Carrière in Rev. Hort. 1858, p. 580 (Nov. 1858). — Hérincq in Hort. Français, 163, 235, t. XVI. (1864). — Engelmann in Trans. Acad. Sci. St. Louis, 3: 41, 55, 210, 212 (1873). — Trelease in Rep. Missouri Bot. Gard. 3: 162, tt. 1, 47 (1892); 4: 185, t. 18, figs. 4, 5 (1893); 13: 96, tt. 52, 53, 54, 84, fig. 8, 95, fig. 2 (range map) (1902).

Yucca aspera Regel in Ind. Sem. Hort. Petrop. 1858, 24 (Jan., 1859); in Gartenflora, 8: 14 (Jan., 1859); 8: 35 (Feb., 1859). — Engelmann in Trans. Acad. Sci. St. Louis, 3: 37 (1873); 210, 212 (1873), as a synonym of *Y. Treculeana* Carr.

Yucca canaliculata Hooker in Bot. Mag. 86: t. 5201 (1860). — Engelmann in Trans. Acad. Sci. St. Louis, 3: 43 (1873); 3: 212 (1873), as a synonym of *Y. Treculeana* Carr. — Baker in Jour. Linn. Soc. Bot. 18: 226 (1880), as a form of *Y. Treculeana* Carr.

Yucca longifolia Buckley in Proc. Phila. Acad. Sci., 1862, 8 (1863); in Gardeners Month. 17: 69 (1875). — A. Gray in Proc. Phila. Acad. Sci. 1862, 167 (1863). — Engelmann in Trans. Acad. Sci. St. Louis, 3: 42 (1873), as a synonym of *Y. Treculeana* Carr.

Yucca argospatha Verlot in Rev. Hort. 1868, 393.

Yucca Treculeana var. *canaliculata* (Hooker) Trelease in Rep. Missouri Bot. Gard. 13: 97, tt. 53, 54, 95, fig. 2. (range map) (1902).

SUPPLEMENTARY REFERENCES. Sub *Y. Treculeana*: Hemsley in Garden, 12: 328, fig., t. (1877). — André in Rev. Hort. 1887, 368, fig. 74. — Sargent, Silva N. Amer. 10: 9, t. 498 (1896); Man. Trees N. Amer. 117, fig. 102 (1905). — Standley in Contrib. U. S. Nat. Herb. 23: 92 (1920).

Plant 2.5–5.5 m. in height, with one or few stems (clumps most often formed about base of old or fallen trunk), few-branched; stem 4 m. or less in height, 0.3 m. or less in diameter, slender, much enlarged immediately at ground. Bark about 0.7 cm. thick, with shallow (on old specimens deep), irregular fissures and fine, broken, circular ridges. Head of leaves broader than long, widest near base, handsome, symmetrical (especially on young specimens). Base of mature leaf about twice as broad as long, its median length 2.5–5 cm., its breadth at insertion 7.5–13 cm., at union with blade 4–6.5 cm. Blade of mature leaf 0.5–1.3 m. in length (averaging about 0.65 m.), narrowed above union with base, then broadened to middle or slightly above, thence tapered to apex, greatest width (flattened) 5–10 cm., (across concavity) 3.2–5 cm., straight, rarely falcate or (near broadened portion) twisted, rigid where narrow, flexible at and above broadened portion, thickened and plano-convex near union with base, elsewhere thin and concavo-convex (the concavity often much flattened), smooth on inner, scabrous on outer surface, rarely scabrous on both, blue- or yellow-green; leaf-margins thin, without separating fibres; apex acute to short-acuminate; spine 0.7–1.2 cm. in length, stiff, sharp. Inflorescence 0.75–1.3 m. in length overall, averaging 1 m. (scape 0.3 m. or more in length, 4–5 cm. in diameter at base);

inflorescence proper narrow below, broadened above, truncate, rounded or rarely acute at apex (racemose tip scarcely exceeding tips of uppermost branchlets), exceeding foliage for about half its length, at anthesis crowded, soon ligneous, glabrous, rarely slightly pubescent, greenish, more or less tinged at first (rhachis, bracts, flower-buds) with reddish purple; branchlets about 25 in number (basal and uppermost approximately 10 cm. in length, central 20–25 cm.), erect- or spreading-ascending, eventually wide-spread; pedicels 1.2–2 or rarely (on basal flowers of branchlet) 7.5 cm. in length, terete or a little flattened, occasionally a trifle enlarged near union with flower; bracts on scape about 12 in number; basal leaf-like ones 30–35 cm. in length, 5–6.5 cm. in breadth at insertion, with base and blade well-defined; uppermost bracts on scape reduced to 15–20 cm. in length, with long, slightly broadened, soft, leathery (chamois-like) lower portion and leafy tip 2.5–5 cm. in length; bracts at base of lower branchlets similar to those on upper scape; those at base of central and uppermost branchlets becoming shorter upward, bract-like throughout with spinescent apex, triangular-ovate, eventually papery; bracts at base of pedicels similar in form to those at base of branchlets, 3.2–4.0 cm. in length, concavo-convex, at first slightly leathery, soon dry; thin, fragile, slender bractlet 2–2.5 cm. in length sometimes present at base of pedicels; flowers globose, small, 2–4 – rarely 5 cm. in length (averaging 4 cm.). expanding broadly at anthesis, with base (united portion of perianth) flat to shallow-saucer-shaped, rarely short-stipitate below, with waxen, brittle, greenish cream to cream perianth-segments rounded to acute, hood-shaped and pubescent at apex; segments of inner row broader, slightly longer and thinner than those of outer row; filaments about 1.6 cm. in length, large in proportion to pistil, just touching each other or overlapping (rarely widely separated) at attachment, their major lower portion flat to rounded, fine-short-pubescent below, papillose above, considerably broadened, thickened near attachment, their clavate tip $\frac{1}{4}$ – $\frac{1}{5}$ of entire filament in length, swollen; anthers about 3.2 mm. in length, the basal lobes $\frac{1}{4}$ of entire length; pistil 2–2.5 – rarely 3.25 cm. in length; ovary slender, 5–7 – rarely 8.0 mm. in diameter, oblong-cylindric, terminating above in well-defined shoulders and short, abruptly narrowed neck, rarely tapered from base to union with style; style 3.2–5 mm. in length, same in diameter, terminating at base in 3 extremely short tips, at apex in 3 abruptly-spreading stigmas nearly horizontal at anthesis, emarginate, with wide-spreading lobes; fruit rather small, 5–11.5 cm. in length, 2.5–3.2 cm. in diameter, oblong-cylindric for most of its length (rarely tapered), for 2.5 cm. below tip abruptly contracted into an acute to short-acuminate apex tipped with dry, persistent style and stigmas, symmetrical, rarely constricted, with primary fissures deeply cleft on contracted portion, broadened into shallow indentations on enlarged portion, with intervening lobes shallowly indented or flattened along lines of secondary dissepiments; old floral base enlarged, thickened, 6-parted; corolla-segments and filaments persistent.

Range. Extending along the Gulf of Mexico from the vicinity of Matagorda Bay to Brownsville, thence west and northwest to the Uvalde and Devil's River regions and north and northeast as far as the environs of San Antonio, New Braunfels and Austin.

TEXAS. Cameron Co.: Brownsville, March 22, 1895, *C. H. T. Townsend* (M). — Brownsville, March 5, 1908, *Griffiths* 9047 (M). — Point Isabel, sea-level, April 7, 1931, *McKelvey* 1763, 1763A, 1764 (photos. 91–1, 4), 1765 (photo. 92–4), 1767 (AA). — Boca Chica, sea-level, April 7, 1931, *McKelvey* 1766 (AA). — Vicinity of Brownsville, June, 1931, (collected by *R. Runyon*) *McKelvey* 2532 (AA). Starr Co.: Near Roma, in chaparral, April 9, 1931, *McKelvey* 1782 (photo. 92–10) (AA). Starr or Zapata Co.: Between Roma and Zapata, in chaparral, April 9, 1931, *McKelvey* 1780 (photos. 93–6, 10) (AA). Brooks Co.: Encino, March 28, 1932, *M. E. Jones* 29083 (UC). Webb Co.: Stony hills n. of Greene, April 7, 1901, *H. Eggert* (2 sheets; M). — Vicinity of Laredo, October 21, 1913, *J. N. Rose* 18022 (W). — Sandy and rocky soils, southwest Laredo, March 26, 1907, *J. Reverchon* 2530 (M; see Frio Co., below). Nueces Co.: Corpus Christi, dry calcareous soil, March 8, 1917, *E. J. Palmer* 11227a (AA). — San Patricio Co.: Near San Cristoval Creek north of Mathis, in chaparral April 5, 1931, *McKelvey* 1704 (photo. 90–9) (AA). Maverick Co.: Near Eagle Pass, May 21, 1932, *McKelvey* 2808, 2810 (AA). Frio Co.: Chaparrals, sandy soil, s. western Dilley, April 29, 1905, *J. Reverchon* 2530 (M; see Webb Co., above). Medina Co.: Medina Creek, April

2, 1932, *McKelvey* 2601 (AA). — Just north of Devine, April 4, 1932, *McKelvey* 2605 (AA). — Medina or Bexar Co.: Between Sabinal and San Antonio, April 2, 1932, *McKelvey* 2597, 2599 (AA). Bexar Co.: Idlewild, January, 1894, received through C. R. Dodge, *L. Beidiger*, *Cat.* 2450 (W); February, 1894, *Cat.* 2475 (W). — At United Gas Station, South San Antonio, plants collected in neighborhood and cultivated, April 4, 1932, *McKelvey* 2606-2 (AA). — Within 18 miles of San Antonio, south on road to Corpus Christi, April 5, 1932, *McKelvey* 2611 (photo. 119-11), 2612 (AA). Comal Co.: New Braunfels, 1846; 1849; 1850; April 5, April 25, 1873, *F. Lindheimer* (11 sheets; M). See footnote, p. 74. — About 10 miles south of New Braunfels, on road to San Antonio, cultivated, April 15, 1932, *McKelvey* 1847 (photo. 96-2) (AA). ? Mason Co.: "Gathered near Loyal Valley, Texas," Nov., 1873, *Muesebach* (2 sheets; M). Gillespie Co.: At Stonewall, cultivated, April 8, 1932, *McKelvey* 2616 (photo. 120-9) (AA). Without precise locality: "Voyage en Amérique Septentrionale (1848-50)," January 1850, *A. A. L. Trécul* 1496 (Mus. Hist. Nat., Paris; **type**). — "Texas," 1875, *Lindheimer* (W).



MAP 4. Ranges of *YUCCA TRECULEANA* (●) and var. *SUCCULENTA* (×).

In 1858, Carrière published in the *Revue Horticole* descriptions of two yuccas which he stated had been brought to France from Texas by A. A. L. Trécul who, in 1848-1850, had visited North America on behalf of the French government. The first, named *Y. lutescens* by Carrière, has been identified with *Y. rupicola* Scheele, described in 1850; Trelease cited the name among synonyms of that species. The second Carrière named *Y. Treculeana* in honor of its collector; his description, taken from a juvenile plant (for he states that it was acaulescent), was of habit and foliage; although the adequacy of Carrière's description may have been questioned, most botanists have considered it sufficient and his name has been almost universally accepted for about eighty years. The writer believes that the description, in conjunction with locality even though only a general one, identifies the species, for Carrière noted the length, breadth and concavity

of the leaves and their non-filiferous margins; he referred to them as evanescently denticulate and this has been noted by other botanists. The only species indigenous to Texas with which Trécul's plant might have been confused are *Y. Torreyi* and the two species of the Faxonianae series, but in all these the leaf-margins are conspicuously filiferous; it has been impossible to find data on Trécul's precise route; that he also collected *Y. rupicola* indicates that he was in a region where *Y. Treculeana* occurs, not in the range of these other species. These facts, together with the traditional use of the name for this concept, make the writer content to apply the name *Y. Treculeana* to our plant.

Professor Humbert of the Muséum d'Histoire Naturelle, Paris, on April 18, 1935, sent to the Arnold Arboretum flowers and inflorescence parts from Trécul's no. 1496, collected January, 1850, on his voyage to "Amérique Septentrionale (1848-1850)." Some flowers show the effect of pressing and drying but others are clearly recognizable as those of *Y. Treculeana*; the flowers are small, the perianth about 5 cm. in length, the pistil 2.1-2.4 cm., the ovary oblong-cylindric, about 3.2 mm. in diameter, with, for the most part, well-defined shoulders; the collector had noted that the stem was sometimes 3.5-4.5 m. tall.

The precise locality of collection is not given. Sargent in his *Silva* stated in a footnote under *Y. Treculeana*: "In 1847 he [Trécul] was sent by the Museum to North America to collect plants and animals, being also commissioned . . . to study the esculent plants used by the Indians of the western plains. Arriving in North America in 1848, he traveled through the region between the Mississippi River and the Rocky Mountains for nearly three years, and returned to France in the autumn of 1850. His collections made during the first year of his stay in America were lost in the wreck of the ship to which they had been intrusted; but those made in Texas and northern Mexico, where he passed the winter of 1849 [this would seem inclusive of January, 1850], reached France in good condition, and included . . . *Yucca Treculeana* . . ." From this it would seem that Trécul's no. 1496 must have been collected in either Texas or adjacent Mexico (where the species also grows). Professor Humbert stated (in litt., April 18, 1935) that Trécul's collection included two yuccas, — his no. 1966 determined by Trelease as *Y. rupicola* Scheele; like *Y. Treculeana*, this grows in south central Texas, and the two may be associated in Mexico, although the writer has never found *Y. rupicola* as far south as the Gulf of Mexico or in the vicinity of the Rio Grande.

Since no specimen from the cultivated plant first described by Carrière has been found, and it is most improbable that any exists, it has seemed justifiable to select as type of *Y. Treculeana*, Trécul 1496 (in the herbarium of the Paris Museum) and to consider the type locality southcentral Texas and adjacent Mexico.

Very similar to the Trécul specimen are the writer's collections from spontaneous plants: San Patricio Co., *McKelvey* 1704 (photo. 90-9; pl. XXXIV), flowers; Cameron Co., 1763, flowers; 1763A, 1764 (photos. 91-1, 4, 7), 1767, flower-buds, miscellaneous material; also photos. 91-11, 92-1, 4. The flowers of all these are small as in the Trécul specimen and as in all illustrations of the cultivated plant. Except in its unusually long filaments *McKelvey* 1847 (photo. 96-2) taken from a cultivated plant, is also similar.

In August, 1864, Hérincq described in the *Horticulteur Français*, with colored plate, a plant growing in the arboretum of Alphonse Lavallée at Segrez; he adopted for it Carrière's name; the description is detailed and the plate, except for the too green ovary, depicts excellently the small, globose flowers of *Y. Treculeana*. The plant originated from a turion found in a shipment of orchids sent from Mexico to Louis Noisette of Nantes in 1849 and bought by Lavallée in 1859; transportation and poor transplanting had injured the plant and, although said by Hérincq to be the handsomest in France, it died after

flowering. Hérincq believed it to be the first *Y. Treculeana* to flower in France or, he says, in Europe.

In January, 1859, two months after Carrière's description had appeared, Regel published two descriptions, one extremely short, of a plant in the Imperial Botanical Garden, St. Petersburg; he called it *Yucca aspera*; in February, 1859, he amplified these descriptions in a third. The specimen came with material sent by Karwinsky from Mexico, — whether seeds or plants is not stated but presumably the former. From the description Regel's plant was probably *Y. Treculeana* but his name, published after Trécul's, has no standing. Engelmann wrote in 1873: "*Y. aspera* . . . of the catalogues, undescribed, as I believe, will probably prove in part to be forms of *Y. aloifolia*, and the names, which cannot be identified now, the original types having perhaps disappeared from the gardens and their native country being unknown, ought to be dropped;" later in the same year: "*Yucca aspera*, Regel, Gartenfl., is the same [as *Y. Treculeana*], to judge from a specimen cultivated here." Since Engelmann Regel's name has been accepted as a synonym of *Y. Treculeana*.

In 1860, with a plate, W. J. Hooker described a *Y. canaliculata*; he wrote: "We were much struck with the beauty of this *Yucca* in the cool greenhouse of W. Wilson Saunders, Esq., Hillfield, Reigate, in the summer of the present year. His flowering specimen had been purchased at the sale of the collection of the late Robert Bevan, Esq., of Bury St. Edmund's; name and locality unknown. A young plant of the same kind had been received by Mr. Saunders, from Paris. It . . . is probably of Mexican origin . . . The plant is probably of considerable age, and has perhaps attained its ordinary size." From Hooker's choice of name and comment upon the plant's "singularly straight, rigid, very concavo-canalculated foliage," it is evident that he was especially impressed by the leaves; he noted that the flowers differed in form and color from those of *Y. gloriosa* and knew of no species with such densely filled panicles. Hooker's species is discussed later in more detail. Engelmann, in 1873, wrote at length of Hooker's plant and stated that it was described from one cultivated at Kew (which would not seem to have been the case). Engelmann had seen a specimen similarly labelled in the Missouri Botanical Garden in April, 1872, and thought that it "very probably is not different from our plant;" later in the same year he wrote: "*Y. Treculiana* [sic] and *Y. canaliculata* are synonymous. If, as it is said, no sufficient character accompanies the name given by Carrière in 1858, and if the first description of *Y. Treculiana* [sic] was published by Hérincq, 1863 . . . then Hooker's name of *Y. canaliculata*, published with description and figure in 1860, would have precedence." Carrière's description evidently was considered adequate and soon the name *Y. canaliculata* was treated as a synonym; however, some botanists such as S. Watson (Proc. Amer. Acad. 14: 252. 1879) and Sargent (Rep. Forest N. Amer. 10th Census, 9²: 218. 1884) used Hooker's name, citing *Y. Treculeana* as a synonym of it.

In 1902 Trelease classified Hooker's *Y. canaliculata* as a variety of *Y. Treculeana*, identifying it with "the broader-leaved plant of the chapparal of the coast region . . ." of Texas and Mexico, with larger flowers than *Y. Treculeana*. As explained later this distinction does not seem to hold good, geographically or otherwise, and is not here accepted.

It is interesting that the name *Yucca canaliculata* was used in France for a garden plant as early as 1858, Carrière in that year citing it as a synonym of *Y. Treculeana*. It would seem that the name was misapplied to an *Agave*, — Carrière himself stating (Rev. Hort. 1859, 391) that one meets occasionally with plants which, although called *Yucca*, probably belong to other genera; "tels sont le *Yucca caniculata* [sic], qui nous paraît rentrer dans le genre *Agave* . . ." From the wording he does not seem entirely

satisfied with the determination but later writers do not cite *Y. canaliculata* Hort. among synonyms of *Y. Treculeana*.

In 1863 Buckley described a *Yucca longifolia*, coming from "western Texas" and flowering in March. His description indicates that he wrote of *Y. Treculeana* for he described the stems as 2–2.5 m. in height, the leaves as 0.75–1 m. in length, with curved, entire margins, the flowers campanulate with ovate sepals, the fruit 10–12 cm. long, cylindrical and obtuse at both ends. From the *First Annual Report of the Geological and Agricultural Survey of Texas* (publ. Houston, 1874) written by Buckley, we learn that, as botanist and otherwise, he served as assistant to Dr. B. F. Shumard and, after his removal, to Dr. Francis Moore. Such part of the survey as was carried on before Buckley's publication of his species *Y. longifolia*, must have been between May, 1860, when work was begun, and April, 1861, when work was suspended; if the date of flowering (March) has any significance as regards date of collection (which is merely hypothetical) he gathered the specimen in March, 1861. On page 113 of the Survey Buckley wrote: "That portion of the State east of Trinity river is called Eastern Texas; Central is between the Brazos and Colorado rivers, and Western west of the Colorado river. . ." By reference to his account of the routes traveled we find that early in March, 1861, Buckley left Austin, Travis Co., and proceeded north through Llano Co., into Burnet Co., and so on, until, in Clay Co., the route again turned south; so that in March he must have been in "western Texas," as defined by him, only when west of the Colorado or when in Travis or Llano Cos.; he crossed to and remained on the east side of the Colorado (his eastern Texas) when he passed from Llano Co. into Burnet Co. It is certain that, whatever his divisions of the state, Buckley in 1860 and 1861 never left the region now regarded as central Texas, for in those years he traveled practically from north to south through the middle of the state; from the region of Austin, Travis Co., south to Corpus Christi he was in the range of *Y. Treculeana* and out of the range of *Y. Torreyi* (the only other species approaching central Texas with which his plant might be confused). These facts, taken with his description, indicate that Buckley's *Y. longifolia* is synonymous with *Y. Treculeana*. Buckley's experiences with the survey were full of difficulties of various sorts; Asa Gray treated his collections with unfriendly criticism and altogether the picture is rather depressing. As far as Buckley's original collection of *Y. Treculeana* is concerned Gray notes that specimen 92 of *Y. longifolia* was not supplied. Dr. Francis W. Pennell wrote (in litt. March 13, 1934): "Gray's criticism of Buckley's species were drastic, but in many instances we are finding that Buckley's species were valid. This was likely due more to the fact that the flora of Texas was so much less known than Gray assumed than to much merit in Buckley's work. . ." Engelmann in 1873 cited, as synonym of *Y. Treculeana*, "*Y. longifolia* Engelm. in sched. 1846; Buckley . . . 1862;" Buckley's publication of the name *Y. longifolia* seems to antedate Engelmann's although the latter is occasionally cited as author!

In addition to horticultural names for *Y. Treculeana*, Trelease (1902) cited "*Y. Vandervinniana* Koch, Belg. Hort. . . ." and "*Y. argospatha* Verlot, Rev. Hort. . . ." Investigation proves them to be little more than garden names but because of the form of citation they had best be mentioned. Koch, describing an exhibit of flowers held at Ghent in March, 1862, stated that *Y. Vandervinniana*, from Texas, seemed to him to be an *Agave*, — its leaves coriaceous, long, lanceolate, dark grayish green, the blade edged with brown; it went by other horticultural names which he cited (Wochenschr. Ver. Beförd. Gartenb. Preuss. 5: 100. 1862; same, translated, Belg. Hort. 12: 131. 1862); this description is inadequate for identification, moreover, Koch did not consider the plant a *Yucca*; the name is, therefore, omitted from synonymy. Verlot, Director of the Botanic Garden,

Grenoble, wrote (Rev. Hort. 1868) that in 1850 plants had been received from the Royal Botanic Garden, Munich, one labelled "*Y. undulata* Mart."¹ Verlot failed to find an author called "Mart." but finally, discovering a "*Y. undulata* Hort.," (cited by Carrière, 1850, among synonyms of *Y. Treculeana*) decided that "Mart." must have been intended for Hort.; when the plant eventually produced a flower-bud Verlot was impressed by its satiny white bracts; his long description indicates that his plant was *Y. Treculeana*; he compared the flowers with those described by Hérincq and found them "blanc nacré," rather than cream-color, as on Hérincq's plant and as on one at the Paris Museum (on which they were greenish white tinged with dark red, not pure white); while Verlot stated that, in vegetative organs, his plant was similar to *Y. Treculeana*, perhaps only a variety, yet, because of the bracts and the untraceable author "Mart.," and the slightly longer pedicels of his plant, he decided to treat it as new *or as yet little known* [italics mine] and to give it the new name *Y. argospatha* (to commemorate the bracts); it is possible that their whiteness may have been due to indoor cultivation! In Trelease's second reference (Belg. Hort. 1870, 23) *Y. argospatha* is merely mentioned among new plants of 1869, — the bracts again stressed; the notice is only a translation of one in the *Gardeners' Chronicle* of 1870. Verlot's plant was undoubtedly *Y. Treculeana* and is cited here among synonyms.

The yuccas were much admired and cultivated on the continent and given many horticultural names which, even after much investigation, could never be satisfactorily verified at this late date. Carrière cited six in 1858; Baker (1880) cited three of those mentioned by Carrière and two others; Trelease (1902) varied the list slightly as did Molon (Yucche, 186, fig. 45. 1914).

Since *Y. Treculeana* was first described from a specimen cultivated in France it may be of interest, before writing of the spontaneous plant, to tell a little of its early history in that country. As the examples with which he was familiar grew in size, Carrière for several years, in some years twice, apologized for first describing the plant as acaulescent; he had noted that vigorous specimens resembled *Agave* and had much in common with the "Broméliacées, avec les *Tillandsia* ou les *Ananas* par exemple;" in a classification of *Yucca* (Rev. Hort., 1859, 390) he placed *Y. Treculeana* in a section *Bromélioidées*, but, after Lemaire (Illus. Hort. 13: 97. 1866) stated that he saw no resemblance to the bromeliads, Carrière did not again refer to his earlier opinion. Carrière wrote (Rev. Hort. 1863, 13, 55) that he saw *Y. Treculeana* in flower for the first time in May and June, 1862, at the André Leroy Nursery, Angers, Anjou province; this may have been considered a misdetermination, for Delaire (Rev. Hort., 1869, 308) named the different places where the species had flowered in France and the Leroy plant is not mentioned; in 1864 it flowered in the Alphonse Lavallée arboretum, Segrez, in 1866 at the Museum, Paris, in 1868 at the Chateau de Villecante, home of Charles Gombault, Dry, near Orléans; Delaire gave a long description of the Gombault plant and noted that it might possibly be a variety (the owner had given it a varietal name), — provided the plants described up to then had really been *Y. Treculeana*! In view of the many horticultural names given this species in France it is interesting to learn from Delaire that Gombault possessed "actuellement 112 espèces et variétés" of *Yucca*! Carrière published (Rev. Hort. 1869, 406, fig. 2) a picture of a young plant of *Y. Treculeana* which was flowering while acaulescent; this figure has been reproduced at least four times subsequently, three times in *The Garden* (Jan., Aug., 1875, and in 1877) and in Nicholson's *Illustrated Dictionary of Gardening*; it grew at the

¹ It seems probable that "Mart." was an abbreviation of the name of K. F. P. von Martius, Director of the Botanical Museum, Munich; all catalogues of this museum to which the writer has had access were issued before 1850; Dr. Suessenguth, the present Konservator, wrote (in litt., August 20, 1935): "Wir bedauern mitteilen zu müssen, dass sich eine so benannte Pflanze weder im Botanischen Museum München, noch im Botanischen Garten München befindet."

home of a Mr. Thorin, Charenton, "route de Saint-Mandé," Carrière gave another long description of the inflorescence and a short one of the fruit which he noted as capsular; it would be interesting to know whether this fruit was artificially produced; references to its presence on European plants are not usual. *Yucca Treculeana* seems to have been astonishingly happy along the Mediterranean; Baker (Kew Bull. Miscel. Inform. 1892: 8. wrote: "This is grown along the whole Riviera, reaching a development far beyond anything which we have at home. In a young plant at Genoa, planted 37 years ago, branching into several heads, the stem was 30 feet long, 4 yards in circumference at the dilated base, and a foot and a half in diameter some distance above the base . . ." The periodicals of Europe and England contain many references to the plant's hardiness, culture, and so on. Hemsley (Garden, 8: 131, fig. 1875) stated that *Y. Treculeana*" . . . is still very rare in England . . ."

Sprenger published (Mitt. Deutsch. Dendr. Ges. 29: 96-149. 1920) two articles about the yuccas, this species among those discussed, and described garden forms, varieties and hybrids, for the most part his own originations; those interested in the cultivation of this genus in Europe will find that these articles and Molon's monograph *Le Yucche* (which follows Trelease as regards spontaneous plants but otherwise is mainly concerned with Sprenger's productions) offer full information. Sprenger's success indicates that *Yucca* hybrids may readily be produced artificially and this is of interest since the many variations found in the field must be largely explained by crossing within one species and true hybrids are believed to occur occasionally.

Engelmann was the first to write of the spontaneous *Y. Treculeana*. He named as range "Texas from the Matagorda Bay and the Brazos and Guadalupe, south and southwestward into Mexico, at least as far as Saltillo, Parras and Chihuahua, on the sea-beach and in the interior, on the gravelly overflowed banks of streams and on the stony declivities of their slopes. . ." This range was based upon "Specimens from Texas and full notes . . . supplied by Lindheimer, Mexican ones by Dr. Wislizenus and Dr. Gregg." The Wislizenus and Gregg collections do not concern us here; the first, from Chihuahua, were later referred by Trelease to the plant now called *Y. Torreyi*, the last to *Y. australis* (Engelm.) Trelease. For *Y. Treculeana* in Texas Engelmann depended upon the Lindheimer collections.

The bulk of Lindheimer's material is in the Engelmann Herbarium; the collector apparently sent supplementary material from year to year and this may have caused confusion; we have at the present time an excellent, very comprehensive collection, poorly assembled; Lindheimer's name does not appear on many sheets undoubtedly his, labels of different dates are mounted on one sheet (in two instances they appear to be with the wrong material) and so on.¹

Most phases of the plant are contained in the collection, with the exception of foliage. There are small, twisting leaves on two sheets (M 140678, 140680) which were determined by Trelease as *Y. Treculeana* but which are clearly those of *Y. rupicola* Scheele, first described from Lindheimer material; they do not conform to Engelmann's description of *Y. Treculeana* in any important particular; the margins are distinctly toothed and, because of their small size, they may have been mistaken for juvenile leaves and have played some part in confirming the impression, begun by Carrière, that the leaves of that species were for a time denticulate. It seems probable that these leaves formed part of Lindheimer's collection of *Y. rupicola*, for they came from the New Braunfels region as did

¹ On the sheets the writer has indicated what, to her, seems to have been the original association of material; this has not been repeated in the citation of specimens where the Lindheimer collections appear according to years, — small flowers (and miscellaneous material) under the typical plant, large flowers under the variety *succulenta* here distinguished; specimens of doubtful origin but perhaps Lindheimer's are mentioned, if important, in the text.

most of his *Y. Treculeana* specimens. Engelmann cited as a synonym of *Y. rupicola*, "*Y. tortifolia*, Lindheimer in sched. 1846;" the twisted leaf mounted with flowers of *Y. Treculeana* (M 140680) was collected in 1846.¹ On the other hand it is probable that three sheets, each with one large leaf, in the Engelmann herbarium and determined by Trelease as *Y. Treculeana*, represent the real Lindheimer collection of foliage; two (M 140664, 140677) bear the name *Y. longifolia* which appears on many Lindheimer specimens, but no collector's name, date or locality with the exception of "Texas" scratched upon one blade; the third (M 140696) bears no data; all conform to Engelmann's description of the large foliage of *Y. Treculeana* and all bear a strong resemblance to still a fourth leaf in the U. S. National Herbarium which was collected by Lindheimer in "Texas," in 1875.

Engelmann described the flowers of *Y. Treculeana* as "1½-2 or even 2½ inches long," noting that "in the Mexican forms I find the segments . . . only 1¼-1½ inches;" Lindheimer collected both large and small flowers; the large, even after drying, still measure 5.7 cm.; they show certain abnormalities, Lindheimer noted them as "7-meris," and we find 7 corolla-segments; the small (Lindheimer occasionally refers to them as "*longifolia parviflora*" or "*longifolia parva*") do not exceed 4.5 cm. and there are even some extremely small ones (only 2 cm.) which were not included in Engelmann's dimensions. The writer has referred the large flowers to the variety *succulenta*, the small to the typical plant; the latter are much the size of those found in *Trécul* 1496 here selected as type.

Trelease considered that *Y. Treculeana* produced a typical form and a variety which, since he took up for it the name *canaliculata*, was evidently based on Hooker's plant; he refers to these as "Two fairly distinct morphological and geographically separate forms. . ." His *Y. Treculeana* has "long and slender" leaves and its flowers are "rather small;" his variety *canaliculata* has "broader" leaves and "larger" flowers. He separates them geographically thus: the typical plant is the "long- and slender-leaved small tree of the Texas region, from New Braunfels west to beyond Devil's river and south to about Torreon, Mexico;" the variety is the "broader-leaved plant of the chapparal of the coast region from about Corpus Christi, Tex., to the vicinity of Tampico, Mex., and, in the foot hills, to about Monterey, Mex." While the writer believes that *Y. Treculeana* produces both a small- and a large-flowered form, she does not consider that the distinctions drawn by Trelease, either morphological or geographical, hold good. First, as to the size of the flowers: although Hooker gave no dimensions he referred to the portion of the panicle shown in his plate as natural size; the flowers scarcely exceed 4 cm. and must, despite the fact that Hooker refers to them as "large," he considered small in comparison with many found in this species; the few flower specimens of *Y. canaliculata* in the Hooker Herbarium, Kew (there is no specimen from the plant described by Hooker), are small, some even smaller than those of his plate. There seems to be no basis, therefore, for considering Hooker's plant large-flowered and, since Trelease's variety *canaliculata* must have been based on Hooker's plant, no basis for believing it separable from the typical, small-flowered plant upon this character. Engelmann considered Hooker's species identical with *Y. Treculeana*, as does the writer. Second, as to the foliage distinctions mentioned by Trelease; these can best be discussed in conjunction with his range distinctions; there is undoubtedly a difference between the foliage of *Y. Treculeana* (as it grows from New Braunfels south to the Gulf and for some distance west of this line) and that of many of the plants growing from about Uvalde west to Devil's River and on to the Pecos — the

¹ There is a sheet (W 23388) of flowers labelled "*Y. tortifolia*, Texas," but lacking other data; the flowers are those of *Y. Treculeana* and bear a close resemblance in size, form and certain abnormalities, to those on the Lindheimer sheet (M 140680) just mentioned.

region of typical *Y. Treculeana* as shown on Trelease's range map (t. 95, fig. 1, no. 1) — and this difference, in so far as it relates to foliage, is much as described by Trelease; for here we find many specimens with longer, more slender leaves than we do further east; the writer believes that this is explained by the fact that *Y. Torreyi* (with often longer, narrower leaves than *Y. Treculeana*) extends east into this region and that many of the yuccas growing there are of mixed parentage, not of a pure *Y. Treculeana* strain. Trelease limits *Y. Torreyi* in Texas to the general region of Presidio, or to much further west; the range of his typical *Y. Treculeana* corresponds closely with the territory where, the writer believes, the eastern limits of *Y. Torreyi* meet the western limits of *Y. Treculeana*; we find in the Uvalde-Devil's River-Pecos River region many plants which are often unstable in floral characters as well as in foliage and which are impossible to identify satisfactorily with either species but in various ways are suggestive of both (see p. 114). Moreover, the writer is of the opinion that, within the species *Y. Treculeana*, there are no foliage distinctions which cannot be explained by either the age of the plant or by favorable or adverse conditions for growth; for all plants of *Y. Treculeana* are handsomer, more symmetrical and produce larger, broader leaves when young than when old (compare pls. XXXI and XXXII, XXXIII) and all do better in sheltered locations (or when protected from wind by cliffs or chaparral) and when growing in richer, moister soil; cultivated plants are generally finer, more luxuriant, than spontaneous ones because of happier growing conditions; in other words geographical location seems to be of importance only in association with these other factors. For all these reasons (although she agrees with Trelease that typical *Y. Treculeana* is small-flowered and that there is a large-flowered variety) the writer does not consider that Hooker's *Y. canaliculata* (with foliage, as indicated by the name chosen, the outstanding character) or Trelease's variety based upon it, represents other than the typical plant in flowers or in foliage; nor does Trelease's concept of the ranges of typical plant and variety (based partly it would seem upon a too limited concept of the range of *Y. Torreyi*) correspond with what she has observed in the field.

Yucca Treculeana was studied in the field in early April, 1931, and in early April and mid-May, 1932, and about 30 collections (most including flowers or fruit) were made and many photographs taken; the major portion of the plant's range was visited. The writer traveled from San Antonio to Corpus Christi, from there to Brownsville, along the Rio Grande from Brownsville to Laredo, from Laredo back to San Antonio; practically all this region lies in the Gulf Coastal Plain. Westward she traveled to Uvalde, Devil's River and the Pecos, to Del Rio, Eagle Pass and Carrizo Springs; the southern and eastern portion of this region lies in the Gulf Coastal Plain, the northern and western portion marks the eastern end of the Trans-Pecos country. In the major part of all this territory *Y. Treculeana* is the only yucca with baccate fruit but in the northwestern part (as has just been noted in discussing Trelease's variety *canaliculata*) the western limits of *Y. Treculeana* interlock with the eastern limits of *Y. Torreyi*; here we are in a country where both geology and flora change, — the capsular-fruited yuccas of the region are also of difficult determination.

It has not been possible to estimate the dominating specific influence in these confusing plants found from slightly east of Uvalde west to Devil's River and to the Pecos River; some would seem to be hybrids; they are cited and discussed only under *Y. Torreyi* (see p. 114) and only appear on the range map of that species although the region in which they are found is roughly indicated by a dotted line on the range maps of both *Y. Torreyi* and *Y. Treculeana*. *Yucca Treculeana*, well-characterized, has been collected as far west from San Antonio as Hondo, Medina Co., and as far southwest as Eagle Pass, Maverick

Co. It occurs in the chaparral along the old road from Uvalde to Eagle Pass and between Carrizo Springs and Uvalde.

The northern limit of *Y. Treculeana* is said by Dr. B. C. Tharp of the University of Texas (in litt., December 16, 1933) to occur "on the edge of the Edwards Plateau near Austin," whence it "follows the edge of the escarpment southwestward through New Braunfels and the northern part of Bexar County . . ." Buckley (whose *Y. longifolia* has been discussed) noted (Gardener's Monthly, 17: 69. 1875) that *Y. longifolia* is common in western Texas, west and southwest of San Antonio; Buckley's "western Texas," in so far as his collections of *Y. Treculeana* are concerned certainly, must be understood as central Texas (see p. 72); he noted that the plant attains 4.5–6 m. west and southwest of San Antonio but is smaller, not over 3 m., in San Saba and Burnet Cos. The writer has not been in these two counties but has traversed adjacent ones to the east, south and west without finding the plant; she has never seen it spontaneous further north¹ than about 12 miles above San Antonio, towards Boerne, where it appeared to be so. Dr. Tharp, in the letter just quoted, wrote: ". . . I do not recall ever having seen this plant either in San Saba or Burnet Counties." The only specimens seen in herbaria which approach this region were collected by Meusebach at Loyal Valley [? Mason Co.], in 1873; while perhaps this species, the collection is poor in quality, labelling and besides may have come from a cultivated plant; it is cited with a question.

South of San Antonio *Y. Treculeana* is found all the way to Corpus Christi, growing mainly in the chaparral where, except when in flower, it might easily pass unnoticed.² Along the Gulf it grows in more open country; at Boca Chica and at Point Isabel (also called Port Isabel), each about 25 miles from Brownsville, it is said to attain its greatest size in Texas; at neither place were plants very plentiful, the greater number were found at Point Isabel. Here, along the Gulf, *Y. Treculeana* is scattered over grassy flats, the best specimens growing behind low cliffs said to have been formed of soil washed down into the sea and redeposited upon the land; on the open flats the plants, although often tall, were weather-beaten and ragged; all vegetation showed the effect of strong prevailing winds. Leaving Austin on April 5, 1931, for Corpus Christi, the writer became more and more disturbed as she approached and left San Antonio; for in Austin plants were in fine flower yet, such a short distance south, they were beginning to go by; fortunately, as has been found true of most yuccas, *Y. Treculeana* produces both early- and late-flowering individuals and, with persistence, one eventually finds the desired material; even as far south as Mathis, San Patricio Co., some inflorescences were in perfection. Mr. Robert Runyon of Brownsville told the writer that the best season of bloom along the Gulf was ordinarily about February and March. From Brownsville to Laredo (a long, lonely, monotonous route) *Y. Treculeana* grows, at intervals, in the chaparral; most were old plants and of an unhappy appearance, — as was all other vegetation; in fact the only robust and vigorous specimens, whether flora or fauna, were the rattlesnakes which surpassed in numbers and size (both length and diameter) any others encountered by the writer. From Laredo to San Antonio *Y. Treculeana* is scattered most of the way but the day's excitement was the finding of a spontaneous group of *Agave americana* (it is recorded from a few Texan localities) about 100 miles south of San Antonio; to meet such a plant

¹ The writer failed to investigate a specimen, apparently spontaneous and it would seem this species, growing about 112 miles from Austin en route to Fredericksburg and San Angelo; map-calculation would place the spot in Mason Co., not far, therefore, from the two counties mentioned by Buckley. That "there is no time like the present" applies especially to plant-collecting!

² Vernon Bailey (N. Amer. Fauna, 25: 16. 1905) quotes Bray (Bot. Gaz. 1901, 103) as stating that the Gulf strip of Texas is approximately indicated by the range of *Acacia Farnesiana* and *Parkinsonia aculeata*; Bailey noted some additional plants, one *Y. Treculeana*, and added: "It is worthy of notice that none of these plants enter the swamp and timber country to any extent."

for the first time in the field and attempt to collect its foliage is an event to remember; under the protection of the great leaves were growing most happily some tiny cacti (*Mammillaria* sp.).

Yucca Treculeana has never been seen in Texas of the great size (15 m.) described by Lindheimer, nor even so tall as the 8-9 m. mentioned by Sargent, but is commonly about 4.5, or, exceptionally, 5.5 m. in height, including the inflorescence some 1 m. taller; in Mexico it is said to be larger; the majority of plants produce a single stem and head of leaves or branch sparingly a few feet above the ground; most of clump habit appear to start about the base of an old stem; none were seen forming the "low impenetrable thickets" mentioned by Sargent. The trunk is generally hidden beneath a thatch of dead, reflexed leaves; the leaf-bases are long-persistent and give a rough, flaky appearance to the bark and their scars remain permanently in the form of narrow, broken, horizontal ridges encircling the stem; the trunk, when denuded of leaves, looks too slender to support the large crown; the only deeply fissured bark examined was old and readily broken from the stem. Beneath the bark the fibres seem to be closely packed, in the center of the stem less densely; when first cut a section of the trunk is exceedingly heavy, when dry extremely light. On young plants the heads of leaves are symmetrical and very handsome, large (about 1 m. in height and 1.5 m. across the base). The writer did not find the leaf-margins denticulate, even on juvenile leaves; there was at most an occasional, slight unevenness; in the field no fibres separate along the margins; the blade is often considerably broadened near the middle and there and above very concave (the base of the concavity often flattened) and flexible; below the middle it is narrow and stiff to rigid; at the point where the blade broadens twisting or decurving sometimes occurs; in color the blade ranges from olive-green to blue-green; the leaf-base is about twice as broad as long (median length) and much thickened on the outer surface by the pressure of adjacent leaves, in color reddish mahogany and very glossy. The flowers are small, globose and numerous; Vasey (Cat. Forest Trees U. S. 38, 1876) refers to them as ". . . shining like porcelain;" they outline the nearly erect branchlets and give a somewhat ribbed effect to the cluster; the pistil is small with slender, oblong-cylindric ovary, short slender style and spreading stigmas. In one instance only (*McKelvey 1704*) longish, fleshy hairs were noted on the neck and shoulders of the ovary, or below the papillose style. Fruit is at times plentifully produced (some 25-50 individuals not uncommon on one cluster) but is often largely hidden by the dry persistent bracts and perianths (see pl. XXXV); it is commonly symmetrical (rarely distorted), rather small, oblong-cylindric for its major lower portion, for a short distance below the tip abruptly narrowed into an acute to short-acuminate apex tipped with the dry, persistent style and stigmas; occasionally it is more ovoid; the perianth and filaments, considerably enlarged and hardened at base, are persistent and for a long time are held erect about the base of the fruit, eventually they reflex; the surface of the fruit is smooth, often greasy to the touch.

Many photographs of cultivated *Y. Treculeana* have been published and the species is readily recognized whether growing in Texas (Sargent in Gard. & For. 1: 54, fig. 10. 1888; Mackensen, Trees, Shrubs San Antonio, 11, t. II., 1909), Georgia (Berckmans in Gardening, 4: 70, fig. 1896), the Riviera (Trelease in Rep. Mo. Bot. Gard. 3: t. 1. 1892), or elsewhere. Specimens are often grown in the cities of Texas, especially fine ones seen at Austin and about San Antonio; the handsomest cultivated plant with a single stem seen by the writer grew in a yard at Stonewall, Gillespie Co., Texas; although growing conditions were not of the best, the ground hard and packed, it was about 5.5 m. tall and 30 large inflorescences were counted, there may have been more (see pl. XXXVI); the handsomest plant of clump habit, whether from a single root system or composed of several

plants was not learned, grew in barnyard soil on the farm of Mr. W. Leuhlfing, 10 miles south of New Braunfels along the road to San Antonio; there were 20 inflorescences, each handsome; the flowers, on the one collected (*McKelvey 1847*; photo. 96-2) had unusually long stamens reaching well above the stigma and pollen might easily have been transferred without outside agent; the owner had no recollection of having seen fruit upon the plant.

It has been indicated by various writers that cultivated *Y. Treculeana* is sterile. Engelmann (1873) stated: "*Y. Treculiana* [sic] is abundantly fertile in its native localities, but will not fructify, as Mr. Lindheimer informs me, in the gardens of the same region." As indicated by notes (M 140682) made on a railroad journey through central Texas to Corpus Christi, Trelease had this in mind; he noted at Taylor, Williamson Co., March 29, 1897: "A few cultivated here in dooryards, now in full bloom. No Pronuba or Prodoxus seen, and the people who own the plants say that the flowers dry up without fruiting. They say they bloom every other year. . ." At San Antonio, the next day, he noted: "A good many plants cultivated, some of them 10 or 15 ft. high, blooming freely. Not a sign of setting fruit though some are out of bloom and the latest are at their fullest now. One gardener, asked, said he never saw fruit on one. The largest and best are at the old Govt. Arsenal. . . About a mile south of Pettus . . . 73 miles from Corpus Christi, several large ones seen, one of flowers and apparently not fruiting. Midway between Normanna and Beeville [the last three towns in Bee Co.], several others seen out of flower, but one in abundant fruit! [Trelease does not mention whether this was cultivated.] About Corpus Christi the Yucca is very scattering, but fruits freely, and as many are cultivated in the city and fruitful, they could be studied easily. This year it was in the prime of bloom about March 15. . ." The Corpus Christi notes would indicate that fruit *is* found on cultivated specimens. Berckmans (l.c.) tells of having tested yuccas for 35 years at Fruitlands, Augusta, Georgia; a specimen of *Y. Treculeana*, planted 18 years, "has flowered with regularity. . . Perfect pollination, either natural or artificial has so far failed here and the plant has remained barren of fruit. . ." Carrière, in 1869, referred to fruit on a plant of *Y. Treculeana* growing at a Mr. Thorin's, Charenton, France, calling it capsular. The *Illustration Horticole* for 1873 stated that a plant at Mr. Linden's nursery fruited with the result that the owner's stock was increased. These references and others do not state whether the plants were artificially pollinated; that would seem probable but, although the moth is the recognized agent, it is possible that other insects may accomplish the same result accidentally. The writer has never seen fruit on the cultivated plant but does not consider this conclusive evidence.

Ellen D. Schulz (Texas Wild Flowers, 47, 2 figs. 1928) wrote: "This Yucca is well named [she cites the common name, Don Quixote's lance] for besides being a veritable arsenal of weapons, it has gone through time with a reputation quite as bold and harmless as the Don Quixote of mediaeval fiction. *Spanish dagger* and *pita* are the more common names given by the early Texans who turned both leaf and flower into service. Even to-day we see Mexicans gathering these long pointed leaves, while green. When needed, the leaves are held over a flame to soften the tissue holding the fibres. The edges are then stripped off, and the strips tied end to end to make them longer. People use these crude twines for tying bundles of cornstalks, oats, and any other fodder. In pioneer days when economy played its part in daily living, the blossoms were gathered in quantities and cooked and prepared like cabbage, or made into most delicious pickles. In ranch life, the yucca is part of the medicine kit. It is not an uncommon experience to use the brownish-black, needle-like points of the leaves in an emergency to fight the serious results of a rattlesnake bite. The firm ends are jabbed deep into the wound of either man or beast. The blood flows freely, carrying off the venom so dangerous to the life of the victim. Some people

think that the dagger carries poison which in some way counteracts the venom, much as an injection of permanganate of potash. Whether or not this is just fancy, due to the irritation caused by a jab into the flesh under normal conditions, we do not know, but we do know that many a life has been saved through its use." Havard (in Bull. Torr. Bot. Club, **23**: 37. 1896) wrote: "Several species of *Yucca*, notably *Y. baccata* Torr., *Y. macrocarpa* Coville and *Y. Treculeana* Carr. . . bear a fleshy banana-like fruit which is delicious when ripe. It contains a large proportion of sugar and is easily converted by the Chihuahua Indians into a fermented beverage which is sometimes distilled by the Mexicans into indifferent aguardiente."

Among common names cited for *Y. Treculeana* are: Texas bayonet (Britton and Shafer, N. Amer. Trees, 155, fig. 115. 1908); Spanish dagger, Texas Spanish bayonet (Sudworth, U. S. Dept. Agric. Miscel. Circ. 92, 48. 1927); Petra plant (Garden, **7**: 405. 1875); "Palma pita," "palma de datiles," Tamaulipas, "palma loca," Nuevo León and elsewhere (Standley in Contrib. U. S. Nat. Herb. **23**: 92. 1920). L. H. Dewey (Yearb. U. S. Dept. Agric. 1903, 398. 1904), discussing the principal commercial plant fibres, wrote: "Some of the palma istle is produced by the plant known as palma loco, or palma pita (*Yucca Treculeana*), found in Coahuila and Nueva Leon. This yucca is very similar in appearance to palma samandoca, though usually with shorter trunk and longer leaves. . ."

***Yucca Treculeana* var. *succulenta*,¹ var. nov.**

Habit and foliage as in typical plant. Inflorescence fleshy, succulent throughout; inflorescence proper narrowed below and above, somewhat slender, at anthesis well-filled but not crowded; flowers campanulate, large, 5.5–7.5 cm. in length; perianth-segments, especially those of outer row, often much thickened, brittle and concave medio-longitudinally; fruit unknown.

Range. Mainly confined to Bexar Co., Texas, and adjacent regions.

For range map see p. 69.

TEXAS. Cameron Co.: Brownsville, grows 2.5–3.5 m. high or more, March 6, 1895, *C. H. T. Townsend* (M). Nueces Co.: Along Nueces Bay, sea level to 6 m., March 12, 1894, *A. A. Heller* 1428 (UC) (P) (AA) (2 sheets; W) (M) (G) (N) (Kew). Frio Co.: 7 miles south of Moore, April 4, 1932, *McKelvey* 2603 (AA). Calhoun Co.: Indian Point [? = Indianola = Port Lavaca], Matagorda Bay, May, 1846, *Lindheimer* 327 (M; excluding leaf). Medina Co.: Just east of Hondo, April 2, 1932, *McKelvey* 2600 (photos. 118–9, 11) (AA; type). — Just north of Devine, April 4, 1932, *McKelvey* 2604 (AA). Bexar Co.: "Western Texas near Leon rr. Station on the El Paso road," October, 1851, *Schott* (M). — 13 miles south of San Antonio on road to Laredo, April 4, 1932, *McKelvey* 2602 (AA). — At United Gas Station, South San Antonio, plants collected in neighborhood and cultivated, April 4, 1932, *McKelvey* 2606–1, 2607 (AA). — At Cassin, April 5, 1932, *McKelvey* 2608 (photos. 119–2, 5) (AA). — Within 18 miles of San Antonio, south on road to Corpus Christi, April 5, 1932, *McKelvey* 2610 (photos. 119–8, 10) (AA). Comal Co.: New Braunfels, 1841, *Lindheimer* (M).

Inflorescences of two distinct types have been observed in the field upon plants of *Y. Treculeana* which in habit and foliage were very similar. The first, or typical form just discussed, is the common spontaneous plant and the one found in cultivation; its inflorescence is soon ligneous, is commonly tapered below and spreading above, with rounded or

¹ Habitus et folia ut in planta typica. Inflorescentia carnosae et succulentae, apicem et basim versus attenuata, elongata et satis gracilis, floribus satis densis sed non arcte congestis. Flores campanulati, 5.5–7.5 cm. longi, segmentis praecipue seriei exterioris, saepe valde incrassatis et fragilibus et medio manifeste concavis. Fructus non visus, verosimiliter ut in planta typica.

acute apex, its branchlets nearly erect and densely covered with globose or nearly globose, small flowers averaging 4 cm. in length. The second form, here distinguished as variety *succulenta*, seems to occur in a more limited area and has not been seen in cultivation except once and the specimen had been transplanted by the owner from a nearby field; its inflorescence throughout is fleshy, succulent, brittle; the flowering portion is elongated, ellipsoidal or nearly so, with an acute to acuminate apex, and has not the ribbed appearance (the flowers outlining the branchlets) of the typical form; at anthesis it is well-filled but not densely crowded for the flowers, while larger, are less numerous than in the typical form; they measure 5.5–7.5 cm. in length and suggest (in perianth only) those of typical, or large-flowered, *Y. Torreyi* except that the base (united portion of perianth) is saucer-shaped rather than gibbose as in the more western plant. The variety *succulenta* seems to bloom slightly later than the typical plant and its bracts are perhaps more highly colored with reds and purples.

The writer has only found this variety in Frio, Medina and Bexar Cos., a somewhat restricted area south and west of San Antonio, never in the Gulf region or along the Rio Grande. Flowers similar in size to the smallest of this variety (5.5 cm.) seem to have been collected along the Gulf of Mexico, — at Brownsville by Townsend, at Nueces Bay by Heller (his no. 1428 widely distributed) and at Indian Point,¹ Matagorda Bay by Lindheimer (no. 327); the writer has not been to Matagorda Bay. Lindheimer also collected flowers of similar size in the New Braunfels region. All these, because of their dimensions, have been cited under the variety and indicated as such on the range map but whether the inflorescences from which they were taken conformed in form and fleshy character to those of the variety cannot now be known; it is possible that they only represented unusually large flowers of the typical plant. In the limited area where this plant has been found, in its northern portions certainly, soil conditions are very different from along the Gulf; for in northern Medina Co., in central Bexar Co., and east and south of New Braunfels, in Comal Co. (where Lindheimer made the collection just noted) the soil consists of "mostly marly clay, chalk and sandstone," rather than of the "sands and gravels. . ." prevailing along the Gulf (Udden, Baker and Böse, Geological Map of Texas, 1916); these regions, to the ordinary observer, certainly suggest a more humid, richer soil and more luxuriant vegetation.

The writer has chosen as type of *Y. Treculeana* var. *succulenta* her 2600 (flowers, foliage) collected just east of Hondo, Medina Co., April 2, 1932; her photographs, nos. 118–9, 11 (see pls. XXXVII, XXXVIII) are of this plant; all are in the Arnold Arboretum herbarium. The flowers represent the small rather than the large dimensions found in the variety.

Of the eight specimens of this variety collected by the writer, seven showed floral abnormalities; although many more specimens of the typical plant were collected only one showed similar abnormalities; the variety, therefore, would seem to be the more unstable form. Typical *Y. Treculeana*, in so far as form of inflorescence and size of flowers are concerned, appears "fixed" and, whatever the conditions of growth, deviates little; for in cultivation too its inflorescences and flowers are much as in the wild. It would be interesting to note the effect of cultivation upon the large-flowered plant.

The writer has never found fruit upon the variety.

¹ Indian Point does not appear on recent maps. *Lippincott's Gazetteer* lists an Indianola as "a former post-village of Calhoun co., Tex., on the W. shore of Matagorda Bay . . ." and states that it was "destroyed by successive cyclones in 1885 and 1886. Its site is occupied by Fort Lavaca." Possibly Indian Point was another name for Indianola, the present Fort Lavaca.

YUCCA SCHOTTII

Yucca Schottii Engelm. in Trans. Acad. Sci. St. Louis, **3**: 46 (1873), in part. — Trelease in Rep. Missouri Bot. Gard. **4**: 185, t. 3 (1893); **13**: 98, tt. 55, 2 figs. 85, fig. 1, 96, fig. 1 (range map) (1902).

Yucca puberula sensu Torrey in Botany, Emory Report, 221 (1859), in large part. Not Haworth (1828).

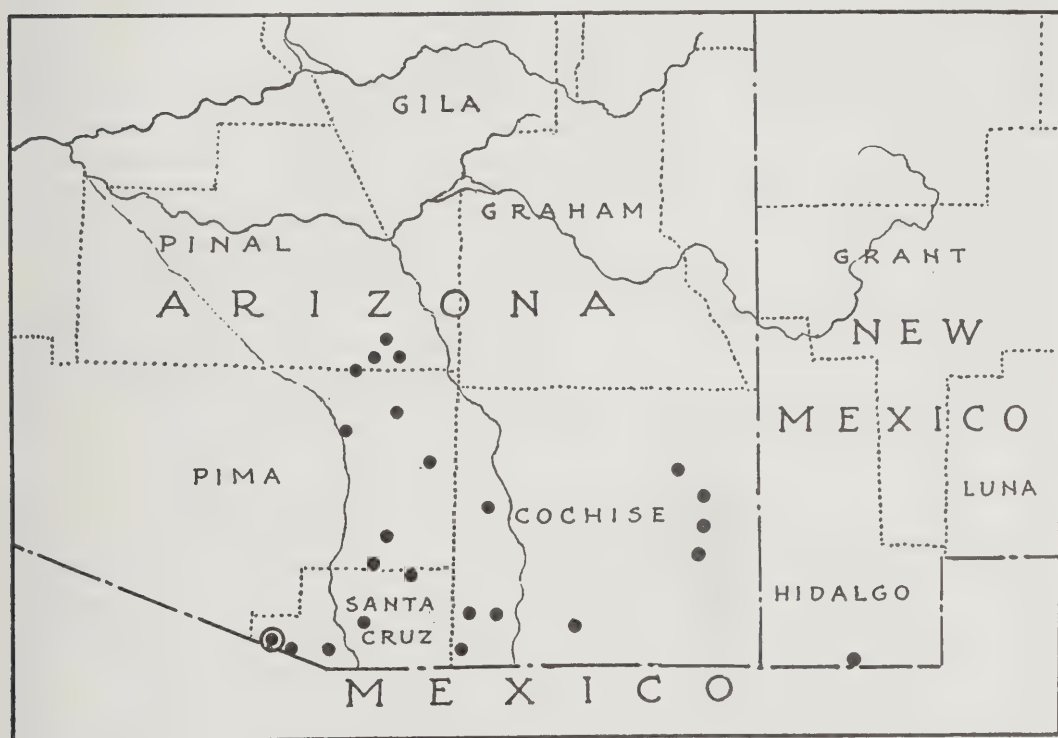
Yucca macrocarpa Engelm. in Bot. Gaz. **6**: 224 (1881); **7**: 17 (1882). — Trelease in Rep. Missouri Bot. Gard. **3**: 162, t. 46 (1892); **4**: 185, t. 3 (1893), as synonym of *Y. Schottii* Engelm. Not *Y. macrocarpa* (Torr.) Merriam (1893).

SUPPLEMENTARY REFERENCES. Sub. *Y. Schottii*: Sargent, Silva N. Amer. **10**: 17, t. 501 (1896); Man. Trees N. Amer. 120, fig. 105 (1905). — Molon, Yucche, 173, fig. 40 (1914). — Standley in Contrib. U. S. Nat. Herb. **23**: 92 (1920).

Plant 2.5–3 to occasionally 4.5–5.5 m. in height with one or, more often, 2–3 stems of varying height. Stem 0.6–2.5 m. in height, commonly covered with shaggy, reflexed leaves below and at top with reflexed-spreading green leaves, 20–30 cm. in diameter (lacking leaves), unbranched or with 2 or 3 nearly erect branches starting 1.5–2 m. above ground, one stem commonly and conspicuously inclined outward from the base. Bark clear reddish brown, marked horizontally by many fine ridges (leaf-scars). Head of leaves 1–1.3 m. in length, 1–1.3 m. or slightly more in breadth near base, flat- or round-topped, crowded. Base of mature leaf small in proportion to size of blade, broader than long, its median length 5–6.5 cm., its breadth at insertion 6.5–10 cm., at union with blade 2.5–3.2 cm., little thickened. Blade of mature leaf 0.5–1.0 m. in length, constricted for about 20 cm. above union with base, then broadened to slightly below the middle, thence tapered to apex, greatest width (flattened) 2.5–6.5 cm., where narrow slightly thickened, plano-convex, where broadened thinnish, concavo-convex, straight, occasionally falcate, smooth, glossy, finely striate on both surfaces, flexible, gray- or blue-green; leaf-margins thin, without free fibres, marked by narrow red line; apex long-acuminate, often with in-rolled margins; spine very short 1.6–3.2 mm. in length, strong, sharp. Inflorescence short, 0.30–0.75 m. in length overall (scape extremely short or nearly lacking), with axis and branchlets often flexuous, slender to stout, covered with dense, pale tomentum, rarely glabrous; inflorescence proper branched from near base, widest (and about same breadth) from near middle to base of racemose tip, exerted for about half its length, not crowded at anthesis; branchlets 10–25 in number, short, at first erect-ascending, at length horizontal or decurving; racemose tip 10–23 cm. in length, surpassing uppermost branchlets; pedicels abruptly decurved, short; bracts on scape few; basal ones 25–30 cm. in length, 2.5–4 cm. in breadth at insertion, their lower half bract-like, thin, a little fleshy, their upper half leaf-like; uppermost bracts on scape 5–11 cm. in length, narrow-triangular, bract-like throughout, rather thin; bracts at base of lower branchlets similar to those on upper scape, upward becoming shorter and slightly broader, ultimately much reduced in all proportions; bracts at base of pedicels 1.2–2.5 cm. in length, 0.7–1.2 cm. in breadth at insertion, narrow triangular, fragile, soon dry, brittle; flowers globose, small, 2.5–3.2 to rarely 4.5–5 cm. in length, not expanding to base at anthesis, with base (united portion of perianth) shallow-saucer-shaped to short-cup-shaped, at times short-stipitate below, often pubescent, with perianth-segments narrowed near base, broadened near middle, acute, pubescent, little thickened at apex; segments of outer row slightly thicker, narrower than those of inner row; filaments short, 1.2 cm. in length, just touching or uniting with those adjacent at attachment, their major lower portion slender, broadened near attachment, their clavate tip $\frac{1}{5}$ – $\frac{1}{4}$ of the entire filament in length, swollen, nearly horizontal at anthesis; anthers 2.5 mm. in length, their basal lobes proportionately long; pistil short, 2–2.5 cm. in length; ovary slender, 5–7 mm. in diameter, oblong-cylindric below with distinct shoulders and abruptly tapered neck; style 3.2 mm. in length, same in diameter, terminating at base in 3 slightly enlarged, extremely short tips, at apex in 3 erect, slightly

thickened stigmas deeply cleft at apex; fruit small, 9–11.5 cm. in length, about 2.5 cm. in diameter, plump, rounded near base, tapering upward at first gradually, for 1.2–2.5 cm. below tip abruptly, the narrowed portion forming a short plump apex, characteristically asymmetrical, commonly distorted (or constricted) 2–2.5 cm. below tip, smooth, glossy; style and stigmas long-persistent; perianth and filaments eventually reflexed.

Range. From the San Luis Mts. of extreme southwestern New Mexico extending west into the Pajarito Mts. and northwest into the Santa Rita, the Rincon and the Santa Catalina Mts. of southeastern Arizona.



MAP 5. Range of *YUCCA SCHOTTII*.

NEW MEXICO. Hidalgo Co.: Summit of San Luis Mts., Mex. bound. line, July 19, 1892, *E. A. Mearns* 526 (W). — San Luis Mts., Mex. bound. line, July 19, 1892, growing close (south slope of peak) to the summit of the highest peak, *E. A. Mearns* 544 (W).

ARIZONA. Cochise Co.: Benson, Jan., 1881, with Parry note attached, *C. C. Parry* (2 sheets; M). — Vicinity of Benson, March 2, 1910, 1.5 m. or less, *J. N. Rose, P. C. Standley, P. G. Russell* 12305 (N). — Rucker Val [ley], Chiricahua Mts., Sept., 1881, *J. G. Lemmon and wife* (UC; as to leaves). — Rucker Canyon, Chiricahua Mts., July 28, 1935, (collected by *O. E. Hamilton*) *McKelvey* 4967 (photos. 169–7, 8) (AA). — Chiricahua Mts., July 23, 1894, *J. W. Toumey* 141 (N); July 24, 1894 (M); July 26, 1894 (2 sheets; N) (CA) (S) (UC) (3 sheets; W); July, 1894 (AA). — Bonita Canyon, Chiricahua Mts., 1800 m., Aug. 19, 1906, *J. C. Blumer* 1823 (N) (G) (M) (S). — Deer Canyon, Chiricahua Mts., 1800 m. (rises to 2440 m.), Sept. 2, 1906, *J. C. Blumer* 1315 (N) (S) (G) (M). — Pinery Canyon, Chiricahua Mts., 1400 m., May 19–August 1, 1919, *W. Stone* (P) (PO). — Between Fort Huachuca and San Pedro River (Huachuca Mts.) July 27, 1893, *E. A. Mearns* 1533 (W). — Fort Huachuca, 1894, *T. E. Wilcox* (AA). — Near Fort Huachuca, August, 1894, *T. E. Wilcox* 374 (W). — Ramsey Canyon, Huachuca Mts., Sept. 30, 1929, *M. E. Jones* 24757 (PO). Santa Cruz Co.: North of Sonoita, July 22, 1935, (collected by *O. E. Hamilton*) *McKelvey* 4963 (photos. 166–7, 8, 9), 4963A (photos. 166–10, 11) (AA). —

"Sierras oeste [west] de S[an]ta Cruz, VII. [July], 1855," A. Schott (M 135693; excluding leaf; in part as to Schott sketch; *type* of *Y. Schottii* Engelm.). — "Sierra del Pajarito, near the Monument, VI. [June], 1855," A. Schott (M 135723; fragments noted as taken from Torrey Herbarium sheet not located; this missing sheet bore date and locality as here cited). — Between Santa Cruz River and Nogales, March 15, 1930, McKelvey 1558 (AA). — Maloney's Mine, Aug. 13, 1900, W. Trelease 393 (2 sheets; M). — Sierra Pajarito, Aug. 14, 1900, W. Trelease 393a (M). — Sierra Pajarito, Aug. 14, 1900, W. Trelease 394 (2 sheets; M; one, noted as "glabrate," bears the same collecting number but is dated Aug. 13, 1900). — Ruby road in Pajarito Mts., March 25, 1930, McKelvey 1631 (AA). Santa Cruz or Pima Co.: In the Canyon of the Santa Rita Mts. . . below our camp, Sept. 26, 1880, G. Engelmann (M 135727, 135728; *type* of *Y. macrocarpa* Engelm.). — Santa Rita Mts., alt. 1400–1800 m., July 9, 1881, C. G. Pringle (G) (AA) (2 sheets; W) (2 sheets; N) (3 sheets; M) (P). — Base of Santa Rita Mts., July, 1884, C. G. Pringle (W) (P). — Santa Rita Mts., Nov. 1, 1891, T. S. Brandegee (UC). — Santa Rita Mts., July 31, 1927, has a short caudex and a scape 1 m. high, R. H. Peebles, G. J. Harrison, T. H. Kearney 4544 (W). — Santa Rita Mts., alt. 1400 m., Aug. 24, 1903, M. E. Jones (PO). — White House Canyon, Santa Rita Mts., July 20, 1935, (collected by O. E. Hamilton) McKelvey 4965 (photos. 168–6, 9, 10) (AA). — Sanford [=Sanfords, near Patagonia], Feb. 22, 1912, Ferris 38/12 (2 sheets; M). Pima Co.: Tucson, Aug. 1, 1934, J. W. Toumey (M). — Rincon Mts., alt. 1800 m., 1891, G. C. Neally 76 (W). — Rincon Mts., July 30, 1894, J. W. Toumey (W). — Rincon Mts., July 31, 1932, panicle 0.9 m. long, floriferous to base. Trunk branching near base, 2.8–3 m. high. Leaves blue-green, thin, flexible, R. H. Peebles, T. H. Kearney 8754 (W). — Mouth of Sabino Canyon [Santa Catalina Mts.] near Tucson, March, 1894, C. S. Sargent (AA). — Sabino Canyon, Santa Catalina Mts., Jan. 24, 1920, E. B. Bartram 458 (P). Pima or Pinal Co.: Santa Catalina Mts., 1881, J. G. Lemmon 303 (G). — Santa Catalina Mts., alt. 1400 m., Aug. 22, 1915, E. A. Goldman 2520 (W). Pinal Co.: Abundant on the north base of hills of Santa Catalina, Arizona, May, 1881, J. G. Lemmon (M). — Oracle, 1929, A. Eastwood (CA). — Near Oracle in Santa Catalina Mts., May 25, 1929, McKelvey 1130 (photo. 22–3) (AA). — East of Oracle on the Mt. Lemmon road, Santa Catalina Mts., March 23, 1930, McKelvey 1620 (photo. 76–8) (AA). — Mt. Lemmon road, 18 miles above Oracle in Santa Catalina Mts., on open hills among scrub oak, July 19, 1935, (collected by O. E. Hamilton) McKelvey 4960 (photos. 165–1, 4, 6) (AA).

In 1859 John Torrey identified with *Yucca puberula* Haworth, a collection made by Arthur Schott while traveling with the United States and Mexican Boundary Survey; Torrey cited two localities, — "Valley of the Santa Cruz river, and Sierra del Pajarito, near the monument, Sonora," the date June. The Santa Cruz River rises in eastern Santa Cruz Co., Arizona, flows south into Mexico where, not far below the border, it makes a loop and turns northward, joining the Gila River in Maricopa Co., Arizona; the Pajarito Mts. lie south of the Tumacacori Mts. and seem to be a Mexican extension of that range; while in a strict sense the name should perhaps be applied only to the mountains south of the border it is used locally, at the present time certainly, for the mountains west of Nogales and on the Arizona side. Schott worked along the border and since none of his three field labels mentions Sonora it seems justifiable to infer that his collections were made in Arizona, not in Mexico; certainly the monument is on the line.

Schott is described (Sargent, Silva N. Amer. 10: 18, footnote 1, 1896) as ". . . a thorough naturalist . . . careful and systematic in his methods. . ." At the present time his collections are confused and his labels have been altered by other botanists; it is possible that the present complexity of his material is due, not to Schott, who seems to have had two species and two localities in mind, but to those who handled his material in the early days. That the Schott collection was an aggregate was surmised by Engelmann and substantiated by Trelease who made two trips to the Nogales region; it has long been accepted as representing *Y. Schottii* (*Y. macrocarpa* Engelm.), misidentified by Torrey as *Y. puberula* Haworth, and also the plant which, in 1935, was renamed *Y. arizonica* but which had previously been called *Y. brevifolia* Schott and *Y. Treleasei* MacBride; Engelmann suspected that still a third species, perhaps *Y. baccata*, perhaps a capsular species ¹

¹ Engelmann wrote (on misplaced Torrey sheet): "This fruit bearing fragment is *glabrous* and bears the immature fruit *erect* on a short *stout* peduncle therefore possibly *not* a *pulpy* fruit which are always pendulous. Schott's plant bears 'Datili' edible fruits. . ." The writer generally has found the fruit of the Treculeanae series erect or erect-ascending in the early stages, that of the capsular species is permanently so; while she identifies this fruit with *Y. Schottii* yet, as Engelmann noted, it might be a capsular fruit; *Y. elata* grows in the Pajarito Mts.; its juvenile fruit is not unlike that of the picture and in June or July might have been about this size.

might be included in a fruit of the collection; the writer has identified it (tentatively, since only its reproduction is available) with *Y. Schottii*.

No types or type localities have been designated up to now for Schott's two species; their selection at this time necessitates an analysis of Schott's collections and labels; since this is tedious it is not repeated in full under *Y. arizonica*; for that species, as for the one under discussion, the reader should refer to the following.

Trelease (1902) repeatedly mentions a sheet in the Torrey Herbarium and it is reproduced in his plate 57; this sheet has not been located and conclusions as to content and labels must be drawn from what has been written of it, from its only fair reproduction and from material noted as taken from it; it evidently comprised two leaf-blades, flowers, inflorescence fragments (some glabrous, some puberulous) and an immature fruit (already mentioned) borne on a glabrous branchlet; the two leaves are unmistakably those of *Y. arizonica*; the rest of the material both glabrous and pubescent would seem to represent *Y. Schottii*, the species under discussion; the Schott field label on the sheet, when deleted of additions made by other botanists, cites the locality "Sierra del Pajarito, near the monument," the date "VI. 25 [?], 1855."

The Schott material now available consists of the following:

(1) A sheet in the Engelmann Herbarium (M 135723) with flowers, a bract and pubescent inflorescence fragments all noted as coming from the Torrey Herbarium sheet and determined as *Y. puberula* of Torrey, not Haworth, by Engelmann; all represent the pubescent and common form of *Y. Schottii*.

(2) A sheet in the U. S. National Herbarium (W 35304) with a puberulous inflorescence fragment and two flowers; an obvious change in the date (from 1855 [?] to 1867) and the vague locality "Arizona," make it of little value; the material represents *Y. Schottii* and perhaps formed part of the original collection.

(3) A sheet in the Engelmann Herbarium (M 135693) with a leaf-blade, unmistakably from *Y. arizonica*, and flowers and glabrous inflorescence fragments of *Y. Schottii*. There are four labels on this sheet, here differentiated as (a), (b), (c), (d). Label (a) would seem to have been written by Schott after Torrey's determination of his material and to represent his attempt to combine Torrey's opinion with his own findings and is therefore of no great importance. Label (b) was written by Engelmann and indicates his suspicion that the Schott material may be an aggregate and, in part at least, identical with his own *Y. macrocarpa* described in 1873; this also is of no great value. The remaining two labels were apparently written by Schott in the field and, judging by the different handwriting and ink, were subsequently altered by other than the collector; since they show that Schott had two yuccas and two localities in mind when he made his collections they are, when deleted of emendations, important; only some punctuation for clarity in reading is here inserted. Label (c) reads at present: "VI. 23. Liliaceae. *Yucca brevifolia* (mihi). (Satili) (Sonor). Valle de Tuback. VI. VII. 1855. Schott;" deleting the insertions (VI. 23. and the *parentheses about the word* Satili) we know that Schott collected the yucca in June and July, 1855, in the valley of Tubac (the present spelling), that he had intended to call it *Y. brevifolia* and that, as indicated by "Satili (Sonor)," it was the Datili, of the Sonorans; for "Satili" must have been Schott's misunderstanding of the name Datili used by the Mexicans for the edible fruit of various yuccas. Label (d) reads at present: "III. 23. Liliaceae. *brevifolia*. *Yucca* (Satili.) (mihi) Sierras oeste de Sta. Cruz. VII. 1855. Schott;" deleting the insertions (III. 23, the word *brevifolia* and the *parentheses about the word* Satili) we know that Schott collected the yucca in July, 1855, in the mountains west of Santa Cruz and had intended to call it *Y. Satili*, — or *Y. Datili*. There is also a sketch attached to this sheet and noted as drawn by Schott; it shows 2 fruits ($\frac{3}{4}$ natural

size), a fruiting plant (its stems noted as 2–2.5 m. high, its leaves 30 cm. long), transverse sections of a leaf and of a fruit, and a seed; it is captioned “*Yucca brevifolia* (mihi) Habitat. Santa Cruz river valley, Sonora.” Any determination of this sketch must be purely hypothetical; the length noted of the leaves and the name indicate *Y. arizonica*; the leaf section as well as the rest of the sketch suggest *Y. Schottii*; it is obviously an aggregate and, to the writer, like the label (a) above, seems to indicate Schott’s attempt to make his findings conform to Torrey’s concept; this is indicated also by his use of the word Sonora which he mentions on none of his field labels. There is also reason to suppose that the sketch was not made in the Santa Cruz river valley for the plant of the sketch is, almost laughably, like two shown in an engraving (no. 42) in the Michler report for which Schott made the “views;” this engraving is captioned “View from monument XV looking west towards monument XIV;” investigation places it at the southeastern end of the Baboquivari Mts., looking west across the Baboquivari Valley. The sketch, for all these reasons, does not seem of any great importance.

Of the foregoing the most important is sheet (3) above and, of its labels, those designated as (c) and (d).

The leaf of this sheet (M 135693) is selected as type of *Y. arizonica* and with it is associated the Schott field label (c) above, which indicates that *brevifolia* was the collector’s choice of name, which cites the valley of Tubac and is dated June and July, 1855. At the present time no yuccas grow directly at Tubac, the type locality, but *Y. arizonica* is found a little further south on the low hills north of Nogales; Tubac lies in the Santa Cruz River valley (the first of the two localities mentioned by Torrey in determining Schott’s collection) and seems merely to explain and make Torrey’s locality more precise.

The flowers and inflorescence fragments of this sheet (M 135693) are selected as type of *Y. Schottii* and with them is associated the Schott field label (d) above, which indicates that “*Yucca Satili*” (or *Y. Datili*) was the collector’s choice of name, which cites the Sierras west of Santa Cruz, and is dated July, 1855. Schott’s interest in this plant, as evidenced in the name which he would have chosen, lay in its fruit; and, since glabrous forms of *Y. Schottii* are rare, it seems likely — Engelmann so believed — that the one on the misplaced sheet belonged, because borne on a glabrous branchlet, with the glabrous inflorescence fragments of this type specimen; the writer has never found the glabrous form of *Y. Schottii* but Trelease also collected it. It is unfortunate that the type represents (even in part) the rare rather than the common form of the species. With the fruit on the misplaced sheet went the Schott field-label citing the “Sierra del Pajarito, near the monument;” it seems justifiable to consider that this merely makes the region where *Y. Schottii* was collected more specific, for the Pajarito Mts. form part of the Sierras west of Santa Cruz; moreover, except for the word Sonora, which Schott himself did not use, it accounts for the second of the two localities cited by Torrey in determining Schott’s collection. The only monuments mentioned in the report of the expedition which lie in the Pajarito Mts. are the numbers XIX and XVIII, — the new numbers 128 and 129; the writer has selected as type locality of *Y. Schottii* the country lying “near” or between them, — since they are only separated by three miles; although she has never been directly at these monuments she has found both of Schott’s yuccas growing in the Pajarito Mts. Schott’s presence both at Tubac and in the Pajaritos is explained in the following paragraph.

Arthur Schott was assistant to Lieutenant N. Michler who was in charge of the western section of the expedition which made a survey of the boundary between the United States and Mexico during the Franklin Pierce administration; Major Emory was in charge of the eastern section and Commissioner of the expedition; the two sections

met near Nogales. When Michler, then at Tucson, Arizona, heard of Emory's arrival at Nogales he went south to meet him; the route he traveled corresponds closely with the present "main road" between these cities and passed through the "deserted village" of Tubac; the rest of Michler's party later went to Arivaca and must also have gone through Tubac before turning southwest; there are many gaps in the narrative but either with Michler or with the Arivaca party Schott must have gone through Tubac, his label ("VI. VII.," June and July) indicates that he did so more than once. Michler, and Schott, were later with the Arivaca party which was working along the boundary between Nogales and the Colorado River; Michler wrote in his report: "Our trail led up a pretty little valley towards the west for eight miles, when we reached the base of the 'Sierra de los Pajaritos' (the Mountain of the Little Birds);¹ . . . we finally reached the point where the monument stands . . . a large live-oak . . . answered the purpose of a monument, (No. XIX from the Rio Colorado.) . . . 'The Sierra de los Pajaritos' is said to form part of the Arizona mountains, reported to be the richest in Mexico . . . The hills are covered with live-oak trees, and are overspread with a rich growth of grama grass. . . Monument XVIII, distant from XIX, a little over three miles, is situated in the same sierra. . ." Soon after leaving monument XVIII the expedition seems to have left the Pajaritos. Major E. A. Mearns who accompanied a later survey, in *Mammals of the Mexican Boundary of the United States* (U. S. Nat. Museum Bull. 56, 1907), gives a concordance of old and new monument numbers (the new become numerically higher westward rather than eastward as did the old); from Mearns' itinerary and main text (p. 107, under Station no. 43) we learn that the Sierra del Pajaritos "extend from Monument No. 126 to Monument No. 142;" this seems to include too great an area and may have been a slip for a relief map of the eastern part of the Papago Country, Arizona (U. S. Geolog. Survey, Water Supply Paper 490-D, 1922) places the new monument 141 at the extreme southeastern end of the Baboquivari Mts., considerably west of the Tumacacori Mts. at the southern end of which extend the Pajaritos.

Torrey mistook the Schott specimens for *Y. puberula* of Haworth which Trelease (1902) stated is "an acaulescent plant scarcely differing from typical *Y. flaccida*," and gave as synonym "*Y. brevifolia*, A. Schott, MSS.," the puberulous inflorescences evidently impressed Torrey so that, because of its connotation, the name *Y. puberula* although misapplied, bears some relation to *Y. Schottii*, the inflorescences of which are commonly pubescent. On the other hand the name *Y. brevifolia* because of its meaning is obviously inapplicable to *Y. Schottii*; it has no standing, being merely published in synonymy (until later validated by Trelease) and is a late homonym of *Y. brevifolia* Engelm. It is best cited under *Y. arizonica*.

In 1873 Engelmann described a new species, *Yucca Schottii*, based upon the Schott collections made on the "Upper Santa Cruz River in Southern Arizona," in June and July, 1855, and wrote: "Some doubt may exist whether all the parts of specimens in Schott's, Torrey's and my own herbarium, all collected by Dr. Schott, belong together; from these specimens the leaves and flowers have been described above, while in the account of the stem and fruit I had to rely on Mr. Schott's notes, who possibly may have mixed the fruit of *Y. baccata* with the foliage of the new plant; but the leaves appear so peculiar that there can scarcely be a doubt about the distinctness of the species to which they belong."

¹ E. A. Mearns wrote of the Pajarito Mts.: "Their flora is said to be usually varied, and the name, meaning 'little birds' mountains, is justified by the abundance of small birds during the breeding season, which is doubtless due to the considerable number of watering places."

In 1881, Engelmann, under the name *Yucca macrocarpa*, described as another new species, specimens of foliage and fruit which he had collected [in 1880] from a plant growing "In ravines of the Santa Rita Mountains south of Tucson, Arizona;" these mountains extend from southern Pima Co. into northern Santa Cruz Co.; he thought the plant allied to *Y. baccata* but distinguished therefrom ". . . by the absence of fibres on the leaf-edges . . . by the smaller, narrow bracts, and the obtuse, not rostrate fruit . . ." Engelmann, a year later, after Pringle had collected flowers in 1881 in the same mountains, commented upon certain characters which did not conform to those of *Y. baccata* and evidently considered the possibility that they might be identical with those of his *Y. Schottii* of 1873: "*Y. Schottii*, Engelm. . . . from Arizona, is known only from Schott's notes and very poor specimens, and has never been identified since. Its panicle is likewise pubescent; its leaves short, narrow and very thick, with few fine fibres. It may possibly be a small-leaved form of *Y. macrocarpa*, which also shows a few thin fibres on the leaves. . . ." Further evidence of Engelmann's uncertainty as to the relationship of his *Yucca*, *Schottii* and *macrocarpa*, is found in his label (see sheet (3), label (b) above) on the Engelmann Herbarium sheet (M 135693); the fact that he believed that the leaves of the Schott specimen belonged with the flowers was the basis of his uncertainty. Trelease, in 1893, first recognized the probable identity of Engelmann's two species, writing: ". . . *Y. macrocarpa* . . . appears to be only this species [*Y. Schottii*]." In 1902 he reduced *Y. macrocarpa* Engelm. to synonymy, noting that "a number of recent writers . . . have come to look upon *Y. macrocarpa* Engelm. as a synonym of *Y. Schottii*." In the Engelmann Herbarium is a collection (2 sheets) made by Engelmann "In the Cañon at our camp, Santa Rita Mountains, Arizona. Sept. 26, 1880;" these sheets are here selected as type of *Y. macrocarpa* Engelm.; the first (M 135727) bears four leaves of *Y. Schottii*; the second (M 135728) four pubescent inflorescence branchlets and miscellaneous bracts; all belong to *Y. Schottii*. It is possible that Engelmann and his party entered the Santa Rita Mts. on the west side, by White House Canyon, but this cannot be verified; the writer has found this yucca growing in the canyon, now much frequented; whether the type locality falls in Pima or Santa Cruz Co. remains uncertain.

Trelease in 1902 took up Schott's manuscript name, *Y. brevifolia*, for the plant now called *Y. arizonica*; he stated that he had visited the Pajarito Mts. and the region of the Santa Cruz River near Nogales, examined the Schott specimens (a sheet in the Torrey and one in the Engelmann Herbarium) and had decided: "If, as now seems more probable than ever, the Torrey sheet of *Y. brevifolia* contains parts of two species, Schott's name may best apply to what Engelmann considered the most characteristic part, the leaves, particularly as the name *Schottii* has now become current for the remainder . . ." Trelease identified Schott's sketch (see sheet [3] above) with the plant now called *Y. arizonica*.

Engelmann's analysis of the Schott material differs from that of the present writer in that he associated together the leaves and the flowers; Trelease (1902) did not so interpret Engelmann's statements for, as noted in the last paragraph, he laid emphasis on that writer's comment that the leaves were distinct and indicated that Engelmann had not associated them with the remainder of the material (flowers and inflorescence fragments) which, from Engelmann's already quoted statement (" . . . from these specimens the leaves and flowers have been described above. . . ") he did do; and, had Engelmann not believed that the leaves of the Schott collection belonged with the flowers, it seems impossible that he could, in 1882, when he had procured flowers of his later species *Y. macrocarpa* (subsequently treated by him as synonymous with his earlier *Y. Schottii*) have failed to recognize their similarity to those of the Schott collection for they are practically

identical; under each species he commented upon the distinctiveness of the leaves but because of different characters in each instance.¹

Trelease, therefore, was the first to prove that Schott's collection represented an aggregate and he restricted the name *Y. Schottii* to the plant then current under that name; he associated the name with the bulk of Engelmann's original material, only the leaves with the plant now called *Y. arizonica*. The writer's choice of types for these species is therefore not only thoroughly logical but is in accord with recent usage.

Yucca Mazeli Chabaud is cited by Trelease (1902) as a questionable synonym of *Y. Schottii*; the references mentioned offer no clue to the plant's identity, merely the following information: (1) Chabaud (Belg. Hort. **32**: 22. 1882) stated that, with ferns and rare yuccas, *Y. Mazeli* grew in the garden of Mr. Mazel of Golfe-Juan; (2) F. Abel (Wiener Illustr. Garten-Zeit. **11**: 347. 1886) after listing 21 species of yuccas, with synonyms and varieties, noted that *Y. Mazeli* is worthy of mention; he does not name the plant among synonyms of *Y. Schottii*, his species no. 18; (3) J. G. Baker (Kew Bull. Miscel. Inform. **1892**: 7) in *Agaves and Arborescent Liliaceae on the Riviera*, wrote under *Y. guatemalensis*, "*Y. Mazeli* and . . . on the other hand, have less firm recurving leaves, and the marginal toothing is sometimes very obscure, and there is a trace of a brown border . . ." This description is inadequate (nor are the leaves of *Y. Schottii* either obscurely toothed or recurving); the synonym, even with a question, may well be omitted. In the herbarium of the Missouri Botanical Garden is a specimen of three leaves, clearly those of *Y. Schottii*, collected by Mr. Alwin Berger at Antibes, October 12, 1900; the plant was cultivated under the name *Y. Mazeli*; this specimen may explain Dr. Trelease's identification of *Y. Mazeli* with *Y. Schottii*.

In 1881, after Engelmann's publication of his species *Y. macrocarpa*, Pringle collected many flower and foliage specimens in the Santa Rita Mts., and these were widely distributed; Lemmon, the same year, got foliage on the north side of the Santa Catalina Mts., Pima or Pinal Co., and Parry from the region of Benson, Cochise Co.; some 10 or 12 years later others made collections, — Sargent in Sabino Canyon, Santa Catalina Mts., Pima Co., and Neally and Toumey in the Rincon Mts., a little further east; in Cochise Co. Toumey found it in the Chiricahua Mts. and wrote (Gard. & For. **8**: 22. 1895) of its occurrence there and Mearns and Wilcox in the Huachuca Mts., about Fort Huachuca. In 1900 and 1902 Trelease made collections, all from the Pajarito Mts., Santa Cruz Co.; he obtained both glabrous and pubescent inflorescences, corroborating the existence of both forms. The only specimens from New Mexico were collected by Mearns in 1892, in the San Luis Mts., Hidalgo Co., close to the Arizona line and to the Mexican border; Mearns notations place it at a high altitude. Most of these collections of *Y. Schottii* were determined as "*Y. macrocarpa*;" the use of this name without citation of author probably accounts for the belief that the plant of the Rio Grande Basin (now called *Y. Torreyi* but long designated as either *Y. baccata* var. *macrocarpa* Torr. or as *Y. macrocarpa* [Torr.] Coville) extended so far east, or into southeastern Arizona; Trelease's range map (t. 98) shows the Texan species in this region.

In Arizona *Y. Schottii* is confined to the southeastern part of the state. It is scattered over most of Cochise Co., — east in the Chiricahua Mts., south in the Mule Mts. (where it was seen by the writer on the Continental Divide west of Bisbee at 1839 m.) and the Huachuca Mts., and northwest in the Dragoon Mts.; it occurs too in the open country about Benson. In Santa Cruz Co. it extends west from the Huachuca Mts., through the

¹ Some botanists such as S. Watson (Proc. Amer. Acad. **14**: 252, 1879) and J. G. Baker, (Jour. Linn. Soc. Botany, **18**: 228. 1880) appear to have followed Engelmann in associating the leaves of *Y. brevifolia* Schott with the flowers.

Patagonia Mts. east of Nogales, into the Pajarito and Tumacacori Mts. west of that city, and north into the Santa Rita Mts.; it is also found in the intermontane regions. In Pima Co. it is found in the north end of the Santa Rita Mts. and in the Rincon and Santa Catalina Mts. (on both north — there extending into Pinal Co., where the writer found it about Oracle — and south slopes); how far it extends west along the ranges such as the Baboquivari in the southwestern part of the county or in the Tucson and Roskrige Mts. in the northcentral portion is uncertain; the writer does not remember seeing it in any of these nor are there any specimens in herbaria; in eastcentral Pima Co. it grows in full sun, scattered intermittently on low hills between Sonoita and Vail, — these plants presumably outposts from adjacent mountains; it occurs about Benson, Cochise Co., close to this general region.

The writer has never seen *Y. Schottii* in New Mexico. The Mearns specimens already noted place it in the San Luis Mts. and Wooton and Standley (Contrib. U. S. Nat. Herb. 19: 137. 1915) record it from Indian Canyon in the Animas Mts., perhaps an extension of the same range; this part of Hidalgo Co. is close to Cochise Co. where the plant is plentiful; it is doubtful if it extends east beyond extreme southwestern New Mexico. Mearns evidently did not find it further east along the border for he noted that *Y. radiosa* (= *Y. elata*) "was the only tree of the deserts between the Rio Grande and the San Luis Mountains;" he considered *Y. Schottii*, which in his work is called *Y. brevifolia* Torrey or "Schott yucca" (the citation of Torrey as author only a slip), to be one of five arborescent species growing along the length of the Mexican Boundary line; since he mentioned the arborescent habit Mearns evidently did not have the plant now called *Y. arizonica* in mind although his use of the name *brevifolia* might so indicate.

Yucca Schottii extends into Mexico, as herbaria testify, and Trelease distinguished, largely upon habit characters, a variety *jaliscensis* ranging from Chiquilistlan to Zapotlan and "frequent in hedges but of undetermined spontaneous range." It is probable that the species attains larger dimensions in Mexico than in the United States.

The writer saw *Y. Schottii* in most of the regions of southeastern Arizona above mentioned but made few collections since always too early for flowers; it blooms later in the season than any other yucca with baccate fruit; most flower-collections seem to have been made between mid-July and mid-August; O. E. Hamilton, who made a trip to Arizona in August, 1935, found most flowers gone by and fruit well formed; his pictures seem to be the best of *Y. Schottii* to date, — the plant has been little photographed. The foliage of *Y. Schottii* is extraordinarily uniform and distinctive; the blade is thin compared to that of most bacciferous yuccas, finely striate, broad, with non-filiferous margins which are marked by a narrow, reddish brown line; the blade is blue- or gray-green, often assuming tones of lavender or brown when dry; some leaves are exceptionally long and narrow, others exceptionally short and broad, length and breadth seem to bear a definite ratio to each other. The species is arborescent, with one or few stems and but few branches; of the stems one at least seems to incline from the base and this nearly habitual tendency has been commented upon by various writers, Sargent, for one, noting that the "trunk is often crooked or slightly inclining;" a photograph attached to the specimen of *Peebles* and *Kearney* 8754 (W 1566497) from the Rincon Mts. shows this characteristic position; whether due to some inherent weakness in the crown or to the fact that the plant is seeking light would be interesting to know; the trunk is rather stout for its length, mostly covered with reflexed-spreading leaves; for a time fragments of old leaves persist and give a scaly appearance to the bark which, when visible, shows many fine fissures encircling the trunk. The heads of foliage are large, crowded with many wide-spreading leaves which, near the base of the head are horizontal or slightly decurved; occasionally in their symmetry they

suggest those of *Y. Treculeana* but again they are asymmetrical and confused. The framework of old inflorescences is persistent and is commonly buried among the leaves for at least half its length because of the extremely short scape; both rhachis and branchlets are often flexuous; branchlets are few, eventually horizontal or decurved, the tip racemose; all inflorescences examined in the field were covered with a persistent fine tomentum or pubescence, — the writer never found the glabrous form represented in a part of the first (or Schott) collection and also in Trelease's material; it is possible that in the glabrous forms the pubescence may be early-deciduous; at times it is found even upon the outer basal portions of the perianth. Fruit in herbaria is mainly symmetrical but that collected by O. E. Hamilton, and his photographs as well, indicate that, in 1935 certainly, it was mainly distorted (as is that of *Y. schidigera*) and constricted at about an inch below the tip (see pl. XLV); its short plump form also suggests that of *Y. schidigera*; both these species seem to produce fruit in great numbers on one inflorescence. Engelmann (1881) noted that its color was that "of a yellow apple, rather pulpy, of a sweetish acidulous taste;" Britton and Shafer (N. Amer. Trees, 156, fig. 116. 1908) refer to it as ". . . black, with thin, edible flesh, when ripe . . ." Sargent (1896) wrote: "The fruit, which in Arizona is produced sparingly, and ripens in October and November . . . at first pale green when fully grown . . . turns orange-color and finally black in ripening; the flesh is thin, sweet, and succulent, and closely invests the thin light brown inner coat." Fruit first forms, as in all yuccas of the sections under discussion, at the base of the inflorescence and before the uppermost flowers have gone by. One herbarium specimen of immature fruit was collected on July 31, most in late August or early September. Toumey stated that the species ". . . is in full bloom by the 20th of July and ripens its fruit by the 10th of September." Unlike other fleshy-fruited yuccas (with the exception of *Y. baccata* which is associated with juniper and pinyon) *Y. Schottii* grows most often among trees, deciduous and evergreen, along shady canyons of mountain ranges although at times it extends into the open, — on rolling hillsides in full sun. The writer found it at elevations of from 1100–1800 m. approximately, but most common at about 1500 m. Sargent (Gard. & For., 8: 302. 1895) wrote: "It is the only arborescent Yucca of the United States which grows on mountains, the other species being found on plains and deserts. Nowhere very common, it appears to grow most abundantly and to its largest size at elevations of from five to seven thousand feet above the level of the sea, although it is occasionally found at lower elevations where cañons open out into the mesas." Toumey, writing of the Chiricahuas, tells us that "It is strictly a mountain plant, frequent in shady cañons at an elevation of from three to six thousand feet. This species seldom gets beyond the foothills. . ."

Sudworth (Miscel. Circ. 92, U. S. Dept. Agric. 48, 1927) cited as names in use for *Y. Schottii*, Spanish-dagger (Arizona), Schott yucca, Spanish-bayonet.

Sargent (Gard. & For., l. c.) wrote: "This is probably the least known of all our Yuccas in cultivation. There are a few noble specimens, however, in the gardens of Tucson, Arizona, and seeds have been distributed last year from the Arnold Arboretum." It grew in the Arboretum of Stanford University as specimens collected by Dudley in 1897 and 1899 testify. Baker (Kew Bull. Miscel. Inform. 1892: 8) wrote; "This [*Y. macrocarpa* Engelm.] I saw for the first time at La Mortola [the garden of Mr. Thomas Hanbury at Ventimiglia, Italy]. It was acaulescent, with a great tuft of very rigid, glaucous ensiform leaves, 2 feet long, 1 inch broad at the middle, with a narrow margin without any threads. It has not yet flowered." In the herbarium of the Missouri Botanical Garden is a specimen received from La Mortola in 1901; its leaves are unusually broad and

coarse but seem to be those of *Y. Schottii*; another specimen from Antibes, France, was collected by Berger in 1900; the plant from which it came was cultivated under the name *Y. Mazeli*.

YUCCA SCHIDIGERA

Yucca schidigera Roezl ex Ortgies in Gartenflora, **20**: 110 (1871); reprinted in Belg. Horticole, **30**: 51 (1880). — Trelease in Rep. Missouri Bot. Gard. **13**: 113 (1902), as a synonym of *Y. mohavensis* Sarg.

Yucca baccata sensu Torrey in Botany, Ives Report, 29 (1861). — Engelmann in Appendix, Botany, Ives Report, 496 (1861); in Trans. Acad. Sci. St. Louis, **3**: 44 (1873), as to Arizona and California specimens. Not *Y. baccata* Torrey (1859).

"*Yucca filamentosa* L.?" sensu Wood in Proc. Phila. Acad. Sci., 167 (1868). Not Linnaeus.

Yucca californica Nuttall ex Baker in Jour. Linn. Soc. Botany, **18**: 229 (1880), as a synonym of *Y. baccata* Torr.

Yucca macrocarpa sensu Merriam, N. Amer. Fauna, no. 7, 358, t. XIV. (May 31, 1893). — Coville in Contrib. U. S. Nat. Herb. **4**: 202 (Nov. 29, 1893), as to California and Nevada plants. Not *Y. macrocarpa* Engelm. (1881).

Yucca mohavensis Sargent in Gard. & For. **9**: 104 (1896); Silva N. Amer. **10**: 15, t. 500 (1896). — Trelease in Rep. Missouri Bot. Gard. **9**: 145 (1898); **13**: 113, tt. 72, 85, fig. 6, 98, fig. 1 (range map) (1902).

SUPPLEMENTARY REFERENCES. Sub. *Y. mohavensis*: Sargent, Man. Trees N. Amer. 119, fig. 104 (1905). — Standley in Contrib. U. S. Nat. Herb. **23**: 94 (1920). — Jepson, Flora Calif. **1**: pt. VI. 314 (1922). — Abrams, Ill. Flora Pacif. States, **1**: 447, fig. 1099 (1923). — Karsten and Schenck, Vegetationsbild. **14**: t. 59 (1926).

Plant of variable habit, most often with several stems, occasionally with one, 2.8–4.5 m. in height, simple or sparingly branched, branches beginning a few feet above ground; stem 0.6–2.10 m. in height, 15–50 cm. in diameter, commonly covered with dead reflexed leaves to ground, rarely with bark exposed on lower portion. Bark rough, broken into flat-topped ridges by conspicuous longitudinal fissures, gray-brown. Head of leaves broader than long, widest near middle, flat-topped, .65–1.30 m. in height, 1.20–2 m. in breadth at widest point, shaggy in appearance, asymmetrical. Base of mature leaf broader than long, its median length 2.5–7.5 cm., its breadth at insertion 4–11.5 cm., at union with blade 2–5 cm. Blade of mature leaf 0.3–0.6–1.5 m. in length, constricted above union with base, then broadened to near middle where 2.5–4 cm. in breadth, thence tapered to apex, straight, rarely falcate or twisted, rigid throughout, plano-convex to near middle, above concavo-convex, smooth on both surfaces, yellow-green; leaf-margins thick, with many detaching fibres; fibres separating late, tough, at first curly, eventually straight; apex acuminate; spine short, 0.7–1.2 cm. in length, sharp, at first flexible, later rigid. Inflorescence 0.65–0.75–1.30 m. in length overall (scape 15 cm. in length or at times as long as inflorescence proper, 2.5–4.5 cm. in diameter at base); inflorescence proper narrow below, broadened above (very rarely ellipsoidal), rounded to flattish at apex (racemose tip surpassing tips of uppermost branchlets by a few inches or about equal to them in height), scarcely exerted or surpassing foliage by about $\frac{1}{4}$ – $\frac{1}{2}$ its length, at anthesis densely crowded, commonly glabrous, slightly scabrous, pale yellow-green tinged with reds and purples; branchlets 15–25 in number (basal extremely short, central and uppermost 20–23 cm. in length), erect-ascending; pedicels 1–3.2 cm. in length, terete, at times thickened at union with flower; bracts on scape few, 4–6 in number; those just above basal leaf-like ones 20–40 cm. in length, 4–5 cm. in breadth at insertion, with short, narrow, thick, fleshy to leathery lower portion and long leaf-like upper portion; bracts at base of lower branchlets 15–20 cm. in length 4–7.5 cm. in breadth at insertion, broad-triangular, thick, leathery to spongy throughout except for extremely short, leaf-like or merely thickened, spinescent or smooth apex; bracts at base of central and uppermost branchlets

similar but becoming smaller upward till reduced to 5–7.5 cm. or less in length, 2.5–4 cm. or less in breadth at insertion, narrow-triangular; bracts at base of pedicels 5 cm. or less in length, 1 cm. or less in breadth at insertion, commonly narrow-triangular (rarely, narrow below, broadened at or near middle) fragile, soon dry, brittle; flowers globose, small, 3.2–4.5 cm. in length (exceptionally 5–7.5 cm.), with base (united portion of perianth) flat to slightly gibbose, occasionally short-stipitate below, with glossy, waxen, often brittle, pale or deep cream perianth-segments narrowed near base, thickened, hood-shaped, acute to rounded, pubescent at apex; segments of outer row slightly thicker, narrower than those of inner row; filaments 2–2.5 cm. in length, just uniting with those adjacent at attachment (rarely separately attached), their major lower portion slender, papillose, their clavate tip $\frac{1}{4}$ – $\frac{1}{3}$ of the entire filament in length, slightly or inconsiderably swollen; anthers 3.2 mm. in length, basal lobes about $\frac{1}{2}$ of entire length; pistil 2–3 – rarely 3.25 cm. in length; ovary stout, 0.7–1.2 cm. in diameter, commonly tapered from base to union with style, rarely oblong-cylindric with distinct shoulders and short neck; style short, 1.6–3.2 mm. in length, with parallel sides, terminating at base in 3 tiny, ill-defined, rounded to acutish, occasionally slightly swollen tips, at apex in 3 erect or scarcely spreading short lobes emarginate at apex, the emargination variable in length; fruit small, 5 – rarely 7–10 cm. in length, 2.5–4 cm. in diameter, tapered upward from plump base (rarely plump throughout), for about 2.5 cm. below tip abruptly narrowed into an acute or short-accuminate tip, characteristically asymmetrical, constricted and variously distorted, with primary fissures sharply cleft on narrow portion, on enlarged portion reduced to shallow indentations, with intervening rounded to flattened lobes slightly depressed along lines of secondary dissepiments; style and stigmas long-persistent in fresh condition; perianth-segments and filaments reflexed, thickened and hardened and forming a conspicuous base.

Range. Extending from the valleys of the coastal slope of San Diego, Riverside and San Bernardino Cos. of California east and northeast across the deserts west of the Colorado into northwestern Arizona and southeastern Nevada.



MAP 6. Range of *YUCCA SCHIDIGERA*.

CALIFORNIA. Imperial Co.: On divide west of El Centro, along road to San Diego, alt. 600 m., April 24, 1932, *McKelvey* 2693 (AA). — Mountain Springs, May 2, 1918, in desert sand, *M. F. Spencer* 816 (N) (G) (PO). Imperial or San Diego Co.: San Felipe Valley, April 10, 1927, *C. F. Meyer* 82 (UC). San Diego Co.: On divide west of El Centro, along road to San Diego, April 24, 1932, alt. 900 m., *McKelvey* 2694-1, 2, 3, 2695-1, 2, 2696-1, 2, 3 (AA). — Descano, alt. 600 m., May, 1923, *Mary F. Spencer* 2274 (G; as to leaf and some flowers). — Jacumba Hot Springs near Monument 233, May 17, 1894, *L. Schoemfeldt* 3215 (W). — Between Jacumba and Mountain Springs, April 24, 1920, *A. Eastwood* (CA). — Mt. Tecate, alt. about 350 m., Oct. 16, 1913, *S. B. Parish* 3706 (AA). — One mile north of Tecati, in chaparral along road, alt. 600 m., Aug. 7, 1927, *J. T. Howell* 2973 (CA). — San Diego, *Nuttall* (G; **type** of *Y. californica* Nuttall). — S[an] D[iego], 12 ft., white sandy soil, April 3, 1862, *J. G. Cooper* (UC). — San Diego, April 21, 1882, *M. E. Jones* 3163 (N) (W) (CA) (PO). — San Diego, May, 1882, *C. R. Orcutt* 262 (M). — San Diego, March, 1894, *C. S. Sargent* (AA). — San Diego, May 15, 1894, *T. S. Brandegee* (AA). — San Diego, Jan., 1896, *T. S. Brandegee* (AA). — Near Coronado Beach, San Diego, March, 1894, *W. M. Canby* (P). — Coronado, sandy, dry, near sea, April 17, 1902, no collector cited [probably *S. B. Parish*], 3092 (S). — Point Loma, April 6, 1913, *A. Eastwood* 2519 (CA). — Del Mar, undated, *B. S. Angier* (2 sheets; AA); May, 1894, *B. S. Angier* (AA); May 8, 1894, *B. S. Angier* (2 sheets; AA). — Del Mar, April 26, 1913, *A. Eastwood* 2971 (CA). — Dodds Canyon at Oceanside, 1 mile from ocean, Upper Sonoran Zone, large caespitose clumps on canyon side, March 22, 1932, *J. A. Ewan* 7168 (PO). — Soledad and San Diego, Nov. 1, 1880, with thin fibre on leaf, other plants hereabouts have very thick fibre, *G. Engelmann* (M). — 20 miles from San Diego on road to San Pasqual, April 25, 1932, *McKelvey* 2703A (AA). — Grassy hills near Bernardo, May 3, 1903, *Leroy Abrams* 3409 (PO) (S; without collector's number) (P) (M) (N) (G). — Hillside between Bonsal and Pala, June 13, 1928, *I. L. Wiggins* 3058 (UC) (S). — Lower end of Japatul Valley, June 16, 1928, *I. L. Wiggins* 3219 (UC) (S). Riverside Co.: Aguanga, so. edge of . . . Co., common on dry slope, April 29, 1922, *P. A. Munz* 5141 (UC) (PO). — West base of Santa Rosa, alt. 1400 m., May 17-June 1, 1901, *H. M. Hall* 1905 (UC). — Palms to Pines Highway, San Jacinto Mts., Feb. 27, March 3, 1936, *McKelvey* 5060 (photos. 179-8, 180-1) (AA). — Cottonwood Spring, April 12, 1924, *B. W. Evermann* (CA). — Palm Canyon, occasional on hills along canyon, alt. 450 m., April 4, 1917, *I. M. Johnston* 1032 (S) (PO). — Between Cabazon and Whitewater River, April 26, 1932, *McKelvey* 2708 (AA). — Borders of the Colorado Desert, Whitewater, April, 1882, *S. B.* and *W. F. Parish* 30 (M). — Whitewater, March 9, 1929, *M. E. Jones* (PO). — Desert near Banning, Sept. 22, 1894, *C. S. Sargent* (W) (AA). — Banning, April 19, 1892, *W. Trelease* (M). — In desert 2 miles east of Banning, Jan. 13, 1918, *R. S. Ferris* 956 (S). Los Angeles Co.: Mts. 20 m.e. of Los Angeles, March, 1878, [*W. H. Brewer*?] (N). — "Found at Los Angeles, California by *Capt. Russell*, 1857, cultivated by *H. G. Bloomer* at San Francisco" (N). — "Rec'd from Los Angeles seeds in San Francisco," *H. G. Bloomer* (M). — "From a specimen cultivated by *H. G. Bloomer* in his garden at San Francisco. Originally from Los Angeles, California" (W). San Bernardino Co.: Colton Hills, May, 1880, *G. R. Vasey* 635 (P; flowers and leaf) (W; as to flowers). — Colton, *D. Griffiths* 257/11 (2 sheets; M). — San Gorgonio, March, 1880, *S. B.* and *W. F. Parish* 30 (AA). — San Gorgonio Pass, April 20, 1882, *C. G. Pringle* 465 (W); same date and locality, *C. G. Pringle* (M) (2 sheets; W). — San Timoteo Canyon, April, 1905, *H. M. Hall* 5751 (UC). — San Bernardino, May, 1880, *G. R. Vasey* (AA). — San Bernardino, a small tree, 1.5-4.5 m. high, April 8, 1889, *S. B.* and *W. F. Parish* (S). — Vicinity of San Bernardino, alt. 300-450 m., April 5, 1895, *S. B. Parish* 3630 (W). — Same, *S. B. Parish* 3636 (G) (N) (UC). — Coyote Holes, south edge of Mohave Desert, dry desert slopes, alt. 900 m., May 7, 1922, *P. A. Munz* and *I. M. Johnston* 5290 (PO). — On pass between Morongo and Yucca Valleys, April 28, 1932, *McKelvey* 2712, 2715-1, 2, 2716-1, 2, 3, 4 (AA). — On pass just west of Morongo Valley, April 28, 1932, *McKelvey* 2718 (photo. 122-8), 2719 (photo. 122-10) (AA). — On flats west of Morongo Valley, April 28, 1932, *McKelvey* 2721 (AA). — Near Victor, Jan. 6, 1891, *F. V. Coville* and *F. Funston* 139 (W 23383; **type** of *Y. mohavensis* Sarg.). — Between Barstow and Lucerne Valley, April 29, 1932, *A. Eastwood* (CA). — Between Lucerne Valley and Stoddard Wells in Granite Mts., April 29, 1932, *McKelvey* 2729-1, 2, 3 (AA). — Southward from Barstow, May 12, 1926, *M. E. Jones* (S) (PO). — Near Goffs on Cadiz-Needles rd., June 13, 1921, *R. S. Ferris* and *C. B. Duncan* 2222 (2 sheets; S). — 78 miles northeast of Barstow on road to Las Vegas, Nevada, April 30, 1932, *McKelvey* 2730-1, 2, 3 (AA). — Between Baker and Yucca Station, April 30, 1932, *McKelvey* 2731 (AA). — Needles, Arizona [=California], Sept. 10, 1894, *J. W. Toumey* (S) (M). — Western slope of Providence Mts., May 29, 1861, *J. G. Cooper* (M; as to flowers) (2 sheets; W). — Bonanza Mines, Providence Mts., rocky mountain side, alt. 850 m., March 30, 1920, *P. A. Munz* and *R. D. Harwood* 3742 (PO). — Lower slopes of New York Mts., near Ivanpah, alt. ca. 1200 m., trunks 1.3-2 m. high, leaves yellow green up to 1 m. long, perianth segments wide-spread, April 21, 1932, *R. S. Harris* and *R. Bacigalupi* 8093 (S) (UC). — 115 miles east of Barstow on road to Needles, May 2, 1932, *McKel-*

vey 2734 (AA). — On road from Barstow to Las Vegas, April 30, 1932, *A. Eastwood 18806* (CA). — Horse Spring, Nevada [= California ?], alt. 900 m., April 17, 1894, *M. E. Jones 5069* (CA) (S) (PO) (UC) (M) (W) (G) (N). — Same locality and date, *M. E. Jones 6059* [= 5069 ?] (M). — Without precise locality, May, 1883, *J. G. Lemmon and wife* (UC).

ARIZONA. Mohave Co.: Fort Mohave, April, 1884, *J. G. Lemmon and wife* (W). — East of Hardyville, July, 1870 [?], *E. Palmer* (M). — Abundant in Sacramento Valley near Union Pass, 1870, *E. Palmer* (2 sheets; M). — "Arizona," August, 1870, *E. Palmer* (W). — Oatman, April 21, 1931, *A. Eastwood 18214* (CA). — On road from Kingman to Oatman, April, 1931, *A. Eastwood* (CA). — Vicinity of Kingman, spring, 1927, *S. Braem* (AA) (S). — Sitgreaves Pass, March 25, 1858, "Ives Expedition" (W). — Drake, August, 1901, *W. Trelease* (2 sheets; M). — Hualapai Valley, 6 miles north-east of Kingman, Nov. 30, 1912, *C. C. Higgins* (W). — 4 miles west of Kingman in Cerbat Mts., April 1, 1930, *McKelvey 1659-1* (photos. 82-5, 8, 10), -2 (photo. 83-2), -3 (photo. 83-7), -4 (photo. 83-4) (AA). — In Cerbat Mts., on road from Kingman to Chloride, May, 1930, (collected by *L. R. Hall*) *McKelvey 16634* (AA). — On flats west of Kingman, May 16, 1931, *McKelvey 2246* (photo. 108-5) (AA). — In valley east of Black Mts. and west of Kingman, May 4, 1932, *McKelvey 2737* (AA). — Between Chloride and Colorado River, on road to Searchlight Ferry, March 7, 1930, *McKelvey 1503* (AA).

NEVADA. Clark Co.: Between Colorado River and Searchlight, May 1, 1934, *McKelvey 4093* (AA). — Searchlight, April 24, 1931, *A. Eastwood 18274* (CA). — Good Springs, April 30, 1905, *M. E. Jones* (PO). — Near Yellow Pine Mine, Spring Mountain Range, May 3, 1934, *McKelvey 4143* (AA). — Bird Spring Range . . . near Las Vegas, March 29, 1934, *I. T. Kelly* (CA). — Near Indian Spring, Charleston Mts., April 3, 1926, *M. E. Jones* (PO). — Charleston Mts., east slope, along road to Charleston Park, May 2, 1934, *McKelvey 4101, 4102* (AA). — Kyle Canyon Fan, Charleston Mts. Gravelly slope, Covillea belt, alt. 1200 m., April 21, 1937, *I. W. Clokey 7474* (G).

In 1871 Eduard Ortgies published in *Gartenflora* an account of the travels and collections of Benedict Roezl made in 1869 and 1870. He stated that in 1869, near San Diego, California, Roezl found two species of *Yucca*; one was arborescent, with short broad leaves edged with stout, pendent, loosely curled fibres and was named by Roezl *Y. schidigera* because he considered it the counterpart of *Agave schidigera*; the second he called *Y. Ortgiesiana*; this had a handsome crown of leaves, on a short stem, suggested the habit of a *Gynierium* [pampas grass]¹, and was armed with many very long, narrow leaves gracefully bent in all directions. Roezl is quoted as stating that the inflorescence-stalk of the first reached 3-4.5 m. in height and bore white flowers which were often colored reddish brown. These short descriptions, in conjunction with the fact that there are but two yuccas indigenous to the San Diego region, leaves no doubt which two species the collector had in mind, — the first, *Y. schidigera*, must have been the plant under discussion which for about forty years has been called *Y. mohavensis*, the second was *Y. Whipplei*.

Ortgies stated that Roezl's name was chosen because of the plant's resemblance to *Agave schidigera*; unfamiliar with this *Agave*, the writer looked up the two plates antedating 1871 which are cited in *Index Londinensis*; of these one (Ill. Hort 9: t. 330. 1862) has foliage similar to that of the fleshy-fruited yuccas, the leaves dark green with filiferous margins; the other (Bot. Mag. 93: t. 5641. 1867) bears no such resemblance. The nomenclature of the cultivated agaves, like that of the garden yuccas, was considerably confused and it would be difficult to determine now just what agave Roezl had in mind. Hutchinson's fig. 59, of *Agave schidigera* (Fam. Flowering Plants, 2: 132. 1934), also shows extremely filiferous foliage or such as is found in the *Yucca* under discussion. The word *schidia*, derived from the Latin, means chip or splinter of wood, and Roezl's name, applicable to the coarse marginal fibres of the leaf-blade, has a certain appropriateness.

Trelease (1902) recognized that *Y. schidigera* was an earlier name for *Y. mohavensis* for he cited it in synonymy without a question and stated in his text: "From the locality there can be no doubt that what Roezl collected near San Diego in 1869 and sold to De

¹ The similarity in general appearance of *Y. Whipplei* and the Gramineae, of which *Gynierium* is one genus, was also noted by Wood (Proc. Phila. Acad. 1868, 167) when he used for that *Yucca* the name *graminifolia*.

Smet under the name *Y. schidigera* was *Y. Mahavensis* [sic], which Dr. Engelmann regarded as intermediate between *Y. baccata* and its variety *australis* as understood by him." Trelease failed to take up the name.¹ Standley's *Trees and Shrubs of Mexico* treated the name *Y. schidigera* as a questionable synonym. MacBride, in a note on the *Abrams 3409* (Gray Herbarium) gives *Y. schidigera* Roezl as a synonym with the comment "practically a nomen nudum." Unfortunately, although Ortgies' description is brief, it is adequate for the reasons given above. The writer regrets that it is necessary to discard a name so long in current usage and because of its connotation so appropriate, but in conformity with the International Rules of Nomenclature feels obliged to adopt the earlier name, *Yucca schidigera*, since there is no doubt (even though none of Roezl's material is available) as to the identity of the species which that collector described. The type locality of *Y. schidigera* is, therefore, near San Diego, San Diego Co., California. No type specimen is known to the writer.

Ortgies tells us that Roezl's two yuccas arrived in Europe in poor condition, what was saved being bought by Louise de Smet of Ghent. The earliest available catalogues of this nurseryman are dated 1874, 1876, 1877 and 1878; in none is *Y. schidigera* listed, although in 1876, *Y. Whipplei* is mentioned as a new plant, not, however, under the name *Y. Ortgiesiana*. Whether de Smet adopted Torrey's name *Y. Whipplei* for Roezl's plant or was introducing material from a different source is uncertain.

Roezl's activities as a collector were astounding. Ortgies tells us that he went from San Francisco to San Diego to obtain *Delphinium cardinale*; the season was late but he collected 2000 plants, which, unlike many of his collections of living material, apparently survived but turned out to be a species with blue rather than red flowers! The *Gardeners' Chronicle* (1598, 1870) states that Roezl collected "850 plants of that extraordinary Orchid, *Telipogon Croesus* (Rchb. f.) . . . [and they] own to a feeling of satisfaction that he did not succeed in bringing a single living tuber of this Orchid to Santa Marta . . . Perhaps, had he been less greedy, he might have been successful in transporting a smaller number of plants, and would not have contributed to the extermination of the plant in the localities indicated, while his own profits from the transaction would have been greater. . ." Although Roezl shipped great quantities of material, in one instance "10 tons of plants" (*Gard. Chron.* 73, 1874), one may rest assured that he did not find it pleasurable to gather yucca in such numbers, with the result that the two San Diego species still survive.

Yucca schidigera was for some 20 years thought to be an arborescent form of *Y. baccata* Torrey. Writing of that species Engelmann (1871) stated that while "Northward a low plant, it becomes a tree² farther south. . ." He named a wide range but no specimens. He wrote (1873) more fully, distinguishing a forma *genuina* and a variety which he called "the southern or Mexican form;" with the Mexican plant we are not here concerned. Of *Y. baccata genuina* he wrote: "The typical plant toward its northern limits is stemless, more southwardly it makes trunks of 1 or 2 to 8 or 10 feet high. . . The Californian forms are in foliage intermediate between the northern and southern extremes; a leaf collected at Monterey and distinguished by its narrowness . . . probably indicates the northern limit of the species." He cited collections of Russell, Cooper and Parry from California, — all of which are *Y. schidigera*, not Torrey's *Y. baccata*.

¹ Ortgies' article actually appeared first in *Gartenflora* in 1871, or nine years earlier than the translation in *Belgique Horticole* cited by Trelease.

² The first, and erroneous, suggestion that southward the acaulescent *Y. baccata* might become arborescent apparently originated with John Torrey, who, in 1861, when writing of the collections of the Ives Expedition, mis-determined a specimen of *Y. schidigera* from Sitgreaves Pass, Arizona, as *Y. baccata*.

Engelmann's concept of *Y. baccata* seems to have been accepted by most botanists. Watson (Bot. Calif. 2: 164. 1880), because of the range which he named, had more than one species in mind; Baker (Jour. Linn. Soc. Botany, 18: 229. 1880) named only *Fendler 249*, here referred to *Y. baccata*, but his range and description show that he included other species in his *Y. baccata*; S. B. Parish in 1891 (Gard. & For. 4: 136) and in 1894 (Zoe, 4: 348) had the "Mohave Yucca" in mind when he wrote of *Y. baccata*. Trelease in 1892 (Rep. Missouri Bot. Gard. 3: 162, t. 2¹) and in 1893 (4: 185, t. 20) wrote mainly of the plant now called *Y. schidigera* since in 1902 he included his *Y. baccata* of those previous years in synonymy of *Y. mohavensis*.

In 1893 Merriam and Coville, the botanists of the Death Valley Expedition, were the first to point out that the arborescent plant of the Mohave Desert region was distinct from *Y. baccata*. Coville wrote under *Y. baccata*: ". . . it is clear that the type form of *Y. baccata* is not the plant with a stout, arborescent trunk, and flowers 3 to 4 cm. long, which ranges from western Texas to southeastern California, and which goes under the simple name of *Y. baccata*. In the Charleston Mountains of Nevada the writer had excellent opportunity to make a comparison in the field between this arborescent plant and a related but trunkless one, both of which are abundant in that locality. There is no doubt that in this region the two are quite distinct, differing not only in their stems and flowers but in the color of their leaves, those of the arborescent species being yellowish green; those of the trunkless species, glaucous . . . the arborescent species receives another name. . . *Yucca macrocarpa*. . ." This name was based on Torrey's *Y. baccata* var. *macrocarpa* and its choice is explained by Coville's statement that "The writer has not had an opportunity to investigate the identity of this Mohave Desert *Yucca* and the arborescent bacciferous *Yucca* of western Texas (which also has been called *Y. baccata*, but which is likewise different from that species), but they are supposed to be the same." Coville cited a specimen of his *Y. macrocarpa* "collected near Hesperia (No. 139);" in his *Catalogue of Specimens* (p. 236) no. 139 is listed as from "Near Victor. . . About 16 kilometers north from Victor, on the road to Stoddard Wells." The two localities are not far distant, Hesperia lying south rather than north of Victor; the specimen itself is labelled "near Victor." Merriam's discussion of *Y. macrocarpa* concerns its occurrence in Nevada and (as he distinguished clearly between it and *Y. baccata*) there can be no doubt of the identity of the plant to which he applied the name.

In 1895 Sargent (Gard. & For. 8: 302) wrote of the "common and only arborescent Yucca of southwestern California," that, "Long confounded with the stemless Yucca baccata of higher and more interior regions, it was first distinguished, under the name of Yucca macrocarpa, from that species by Doctors Merriam and Coville. . . The name macrocarpa, however, having been previously applied to two ² other species of Yucca, this coast species is still in need of a name." In the same periodical, in 1896, he wrote: "The habit of this southern California Yucca, the color, surface and margins of its leaves, and the size of its flowers abundantly distinguish it from the stemless Yucca baccata of Torrey and from Yucca macrocarpa of Texas. It is without a name, and I propose to call it Yucca Mohavensis as it is most abundant and grows to its largest size on the Mohave Desert, this too, being the name which Dr. Coville . . . gave it in his manuscript notes of the expedition." In the same year, in the *Silva*, Sargent amplified his description of *Y. mohavensis*.

¹ This illustration appears also in *The American Florist* (8: 62, fig. [p. 57] 1892); but it is certain that the writer, unnamed, included two species at least in his *Y. baccata*. Orcutt (Amer. Plants, 2: t. [opp. p. 725] 1909) also reproduced this plate in writing of *Y. baccata*.

² Sargent refers to *Y. macrocarpa* Engelm. (= *Y. Schottii* Engelm.) and to his own misapplication of the name *Y. macrocarpa* (Torr.) Merriam to the species *Y. Faxoniana*.

Sargent had ample material of flowers; he had stressed their size (although he did not then state whether large or small) in naming *Y. mohavensis* and distinguishing it from the plant of the Rio Grande basin; his amplified description in the *Silva* of 1896 was based (to judge by their "Silva of N. Amer." labels) upon 5 different collections, 10 sheets; among these Sargent's own collections (leaves only) came from near Banning and San Diego; all 5 collections are from San Diego and Riverside Cos., none from the Mohave Desert where Sargent stated that the species reached its best development. Because of the connotation of the name *Y. mohavensis* which Sargent chose, reinforced by his reference to the Mohave Desert, and by his statement with regard to Dr. Coville, it seems fitting to choose as type of *Y. mohavensis* Sarg. the *Coville* and *Funston* 139 (W 23383) which came from a precise locality in the Mohave Desert, "Near Victor;" moreover, Sargent stated that Coville had associated the binomial with the plant in his manuscript; also the two large, broad, thick, rigid leaves of his specimen are highly characteristic of the species; Sargent stressed, equally with the flowers, the leaf-characters of the plant.¹

Alphonso Wood wrote of his trips made in January and February, 1866, in the vicinity of San Diego and Los Angeles; from the last he made excursions to San Gabriel, the Granite Mts., San Bernardino and other localities. He seems to have collected three yuccas and determined each with a question; to the first, evidently *Y. Whipplei*, he gave the name *Y. aloifolia* L.; to the second, the same species, the name *Y. graminifolia*, believing it might possibly be a new species; the third he determined as *Y. filamentosa* L.; the last two he collected in the "Mountains east of Los Angeles . . ." Of his *Y. filamentosa* he wrote; "Only the leaves seen (March 3d), which are densely clustered, yellowish-green, with brown spots and transverse lines at intervals, with no mid-vein, thick, lance-linear, rolled above and sharp-pointed, margin splitting into strong, recurved filaments." From description and locality there can be no doubt that this plant was *Y. schidigera*.

J. G. Baker (1880) cited "*Y. californica* Nuttall herb.!" as a synonym of *Y. baccata* Torrey. In the Gray Herbarium is a specimen of flowers and a small inflorescence fragment; one label indicates that it came from the Nuttall collection and was presented by Elias Durand in 1866, another label reads, *Yucca californica* S. Diego N. Cal.; the flowers are those of *Y. schidigera*. The name was only cited in synonymy and has no standing. This sheet is chosen as type of *Y. californica* Nuttall, the type locality San Diego. There may be another sheet in the British Museum for Nuttall's collections were divided.

The greater part of the early collections of *Y. schidigera* are found in eastern herbaria, more recent ones, with the exception of the writer's own, in western herbaria. The species is plentiful in and about the Mohave Desert of California, in adjacent Arizona and Nevada.

The earliest collection of *Y. schidigera* from California was long thought to have been made by Parry at Monterey, Monterey Co.; the specimen is in the Torrey Herbarium and consists of one small narrow leaf such as is sometimes found on old plants of *Y. schidigera*; *Y. baccata*, the only California yucca with foliage that might possibly be mistaken for that of *Y. schidigera*, certainly does not grow so far west; nor is the presence of *Y. schidigera* near Monterey now accepted by Californian botanists. Abrams (Bull. N. Y. Bot. Gard. 6: 335. 1910) wrote: "This species is said to have been collected near Monterey, but we strongly suspect that this is an error through confusion of labels. Parry's plant in all probability came from San Diego, for so far as we are aware the plant has not been found in the coastal region north of that locality." Dr. Jepson in reply to an inquiry about

¹ The specimen bears two labels; that on the left is dated 1891, that on the right 1881; the last may be disregarded since only for convenience in the herbarium; the wrong date must have been due to carelessness in filling in a label printed "188-".

the Monterey locality wrote (in litt., Nov. 18, 1936): "On account of my long experience in California field work it never occurred to me to give any credence to the reported occurrence of *Yucca mohavensis* in Monterey County as stated in old time records; nor, indeed, any particular thought, it is so improbable. . . For many years — now four decades — I have trailed widely through the mountains of Monterey County. So prominent a species could scarcely escape detection by myself or by many other observers. . . ." The Monterey region, therefore, may be disregarded.

There is one specimen from Los Angeles Co., which, from the notation "Bot. Calif. 1878," was probably made by Brewer although no collector is mentioned. Brewer is known to have worked about the San Gabriel Mts., and around the San Gabriel Wash near Azusa; the locality, "Mts. 20 miles n.e. of Los Angeles," falls in this region. Another still earlier collection was made at Los Angeles by a Capt. Russell in 1857; this was cited by Engelmann in 1871 but the only specimens bearing Russell's name came from a plant growing in the garden of H. C. Bloomer in San Francisco and originating from Russell's collection. Los Angeles should be considered regional. There are no other records from Los Angeles Co. but Dr. Ivan M. Johnston assures the writer that he is satisfied that *Y. schidigera* occurs about Claremont, along the foot of the San Gabriel Mts. some 20 miles east.

The major part of the Californian collections of *Y. schidigera* are from San Diego, Riverside and San Bernardino Counties. When en route from Arizona to San Diego the writer found it in Imperial Co., at about 600 m., on the east slopes of the divide west of El Centro, in fruit on April 24, 1932. In San Diego Co., the same day, it was in flower at about 900 m., on the west slope of the Laguna (?) Mts., as well as about Jacumba Hot Springs and Alpine; *Y. Whipplei* was also in bloom; in form of inflorescence the plants about Alpine were suggestive of *Y. baccata* but the flowers had not the long pistil nor large campanulate flowers of that species and the stems were tall. The Parish specimen from Mt. Tecate comes from near this region of central San Diego Co., — from a little further south than the Jacumba locality. North of San Diego, on the way to San Pasqual, the writer saw a few plants, peculiar in that they were flowering while stemless, the inflorescences only 20–30 cm. long overall and nearly buried in the foliage; they probably represented some abnormal condition for they grew in moister soil than ordinarily and in one with considerable humus; such conditions might, however, be expected to produce larger, though perhaps weaker specimens; most plants of the region were of the more familiar, taller habit. Collections record it from along the sea, — from San Diego, Coronado, Del Mar and northward as far as Oceanside. San Felipe Valley cited by Jepson (1922) may lie in San Diego or in Imperial Co., San Felipe Creek running eastward through both and emptying into the west side of the Salton Sea. In Riverside Co., northwest of Indio, the species was in fine fruit on April 26, 1932, and, not far east of Palm Springs station, stretched for a number of miles in great abundance; again it was found between Cabazon and Whitewater River. In the winter of 1935–1936 the writer had the opportunity to study the plant in the eastern part of this county. Along the southern part of the Palms to Pines Highway which crosses from the east to the west slope of the San Jacinto Mts., it began at about 450 m. where it was more shrubby than tree-like, and extended, somewhat taller, to about 1100 m.; a series of photographs of one abnormally early inflorescence, the bud taken on February 27, was brought to an abrupt close on March 6 when the entire inflorescence was removed by a motorist (see pls. XLVIII, XLIX). Descending by the same road the west slope of the San Jacinto Mts., towards Hemet, the species was found again, — it had disappeared along the higher portions of the road; and it was plentiful in the pass crossing from near San Jacinto to Beaumont, the plants here with unusually

long leaves. *Yucca Whipplei* (while extending higher than *Y. schidigera* and reaching its best development along the summit rather than on the east or west slopes of this Palms to Pines Highway) was frequently an associate. The recently established Joshua Tree National Monument, comprising some 825,000 acres of desert land, should preserve, in addition to the tree for which it is named, this species of *Yucca* as well; in the northwestern part of the Monument (mainly within Riverside Co.) *Y. schidigera* is found frequently between Keyes Ranch (which seems to be over the county line in San Bernardino Co.) and Inspiration (or Keyes) Point; in the southwestern part it is plentiful in and about the Cottonwood Mts. From San Bernardino Co. there are many records of occurrence. The writer found it from Whitewater to Morongo and Yucca Valleys, — especially abundant in the pass from the mesa above Whitewater into Morongo Valley and in the pass from Morongo Valley into Yucca Valley; within the two valleys the Joshua-tree was the prevailing yucca. On April 29, 1932, *Y. schidigera* was fruiting heavily in these regions; in the early winter of 1935–1936 much unripened fruit remained upon the trees, the branchlets spreading broadly under the weight; it was not uncommon to find shrub-like plants with many tall stems, sometimes 8 or 10. Mr. C. B. Wolf (Rancho Santa Ana Occasional Papers, ser. 1, no. 1, 33, 1935) comments upon the fact that in a considerable area of Morongo Valley this species is characterized by “glaucous, blue-green” leaves, rather than by the “yellowish-green” ones found throughout most of its range; he notes: “The seedlings from this collection have from the first shown the same blue-green leaves that were characteristic of the parent,” and he suggests that such a strain may be of botanical and especially of horticultural interest. The writer has found the foliage of most baccate yuccas a bluer green when juvenile than when mature and the young leaves in the center of a head bluer than those surrounding them; in 1932 and in 1935–1936 she noted of the plants in the Morongo Valley region that the foliage varied from blue- to yellow-green but a strain with leaves truly distinctive in color would be of interest. On the hills outside Victorville and in the desert north of Box S Ranch near Lucerne Valley, it was flowering abundantly in late April, 1932, as well as in the Granite Mts. further north; about 80 miles northeast of Barstow, en route to Las Vegas, Nevada, the flowers were about over; to the south of the Shadow Mts. it was plentiful; on the road from Barstow to Needles it grew before reaching Fenner and was fruiting sparingly; here it was common for some 15 miles, then stopped, beginning abruptly again further east in association with *Opuntia Bigelovii*; on the descent to Needles it did not extend to the low elevation reached by that cactus; no Joshua-trees were seen along the road between Barstow and Needles. There is a Cooper specimen from the Providence Mts. which bridges the gap between the writer’s collections made south of the Shadow Mts. and those from near Fenner. Jepson (1922) records *Y. schidigera* from the Ord and Calico Mts., not far southeast and northeast respectively of Barstow. Many others have collected it in parts of San Bernardino Co. not traveled by the writer and it seems to be common in the greater part of that county. The widely distributed M. E. Jones specimen from “Horse Spring, Nevada,” may have come from the town of that name in extreme northeastern San Bernardino Co., not far from the Nevada line. The most northern record in eastern California is Merriam’s; he states that the Death Valley Expedition found it “on the North Kingston Mountains, between Resting Springs and Pahrump Valley, Nevada;” this would seem to fall (on recent maps) in the southeastern corner of Inyo Co., California.

In Arizona *Y. schidigera* seems to occur only in westcentral Mohave Co., or north, south and west approximately of the Kingman region. The writer found it in the southern part of Detrital Valley and in the foothills of the Cerbat and Black Mts. bounding it on the east and west respectively; it was found along the upper portion of the abrupt descent

from near Chloride to the Searchlight Ferry. In the northern part of Sacramento Valley and in the foothills of the Hualpai Mts. to the east and of the Black Mts. to the west it was plentiful, — in the latter, about Oatman and about Union Pass (where Palmer collected it in 1870) a little further north; in this Pass were some of the finest, largest, most vigorous specimens seen anywhere by the writer. Precisely how far north in Detrital Valley or south in Sacramento Valley the plant extends is uncertain for herbaria only offer examples from much the regions mentioned above, — Hardyville (*Palmer*, 1870) and Fort Mohave (*Lemmon*, 1884) located not far from Oatman, while Sitgreaves Pass (where the species was first collected in the state on March 25, 1858, by an unnamed member of the Ives Expedition) is presumably not far distant. (The writer has not located this Pass definitely; Meadow Creek, where the Ives Expedition camped on that date is illustrated in the Report and *Y. schidigera* is shown on the heights overlooking the Colorado; the specimen, a most excellent one of flowers, was misdetermined by Torrey as *Y. baccata*.) The writer did not find the species in the Littlefield region of extreme northwestern Mohave Co., and it perhaps does not cross the Colorado to the north of Detrital Valley. Apart from the writer's, only nine specimens of *Y. schidigera* from Arizona have been found in the many herbaria examined.

In Clark Co., southeastern Nevada, *Y. schidigera* was plentiful on the climb from the Colorado River to Searchlight and in the desert and on the low hills east of that town; northward it extended for many miles along the road to Las Vegas. It was abundant in the desert northwest of that city and mounted the east slopes of the Charleston Mts. to about 1700 m.; here it was fruiting heavily on May 2, 1934. Southwest of Las Vegas, in the Spring Mts. west of Good Springs, it began in the desert at about 900 m. and extended a short way up the slopes; here again it was in fruit. *Y. baccata* also grew in these regions and the two species in habit, foliage and fruit were not to be mistaken; the dwarf variety of the Joshua-tree was another associate. Traveling from Las Vegas to St. George, Utah, *Y. schidigera* was found northeast of Las Vegas, growing at about 700 m. or lower than in the Charleston Mts. and Spring Mts. region; it was not seen in the Valley of Fire (through which a detour was made from south of Crystal, the main route rejoined near Glendale); it was met again about 16 miles beyond Glendale, — its most easterly stand so far as is known to the writer. Merriam's records are the best available for the state of Nevada; he wrote that it was "found in but few localities traversed by the expedition;" he stated that it "finds its western limit . . . on the North Kingston Mountains, between Resting Springs and Pahrump Valley, Nevada [as noted in discussing the plant's range in California, this would seem to fall in Inyo Co., in that state]. It begins again on the east side of Pahrump Valley . . . and ranges up on the west slope of the Charleston Mountains. . . On the east side of the Charleston Mountains it begins at an altitude of 1,525 meters (about 5,000 feet), and descends to the upper part of Vegas Valley, near Cottonwood Springs. . . On the north side of the Charleston Mountains this species occurs sparingly throughout the higher parts of Indian Spring Valley. . . It is common on the low divide about 27½ kilometers (17 miles) west of Indian Spring. . . and thence is continuous westerly along the south (or highest) side of the valley to the cañon separating Indian Spring Valley from the Amargosa country, and occurs scattering on the west or Amargosa side, skirting the higher slopes. In the north arm of Indian Spring Valley it is common and conspicuous. . ." From the above the plant's most northern record in Nevada seems to be in Nye Co., — in the region of the Amargosa Desert and further south about Pahrump Valley; it probably extends, about the north arm of Indian Spring Valley, into extreme southwestern Lincoln Co. (on Merriam's map Lincoln Co. is evidently comprised in Clark Co.) whence it extends into southwestern Clark Co. The highest altitude recorded is 670 m.,

in the north arm of Indian Spring Valley; the lowest is 900 m., near Cottonwood Springs in the Vegas Valley. Merriam mentioned that it was in bloom on April 29 and 30. The largest plants were on the west slope of the Charleston Mts., many "reaching the height of $2\frac{1}{2}$ meters (8 feet), and some growing as high as 3 or even 4 meters (10 to 13 feet)."

According to Merriam *Y. schidigera* "was not found on the Beaverdam Mountains or in any other locality" in Utah; nor did the writer find it in her travels in that state. Tidestrom (Contrib. U. S. Nat. Herb. 25: 126. 1925) does not give Utah as part of the plant's range.

The writer found *Y. schidigera* growing for the most part in intermontane valleys or on the foothills of adjacent mountains and from near sea-level to an altitude of 1700 m., but it may extend higher; it seems to prefer arid, desert conditions although it mounts into the lower part of the Juniper and Pinyon belt; it grows in often widely separated stands in which individual plants are rarely contiguous; in many regions it is associated with *Y. baccata*, less often with the Joshua-tree¹ and, in California only, with *Y. Whipplei*. As noted under *Y. baccata* the altitude ranges of *Y. baccata*, *Y. schidigera* and *Y. brevifolia* were clearly demonstrated on the eastern slopes of the Charleston Mts. of Nevada. The season of bloom of *Y. schidigera* begins in late March and extends into early May; as in most yuccas some plants are early, others late bloomers and at times both well-developed fruit and flowers have been noted in the same region; altitude perhaps more than latitude seems to determine the date of flowering. As a rule flowers are produced upon plants of good size and are almost universally globose and small, 3.2–4.5 cm. in length; of the many specimens collected and observed in the field only three had flowers more campanulate in form and attaining 5.7–6.5 cm. in length; in herbaria the largest were 7.5 cm. in length (Orcutt 262), the segments long and narrow; there were several 5.7–6.5 cm. in length (Parish 3630, 3636; Munz 5141) with narrow segments; Sargent (Silva) gives the dimensions as 1.2–6.5 cm. In form of certain floral parts we find instability; the base of the flower (united portion of the perianth) may be flat or gibbose, occasionally short-stipitate below; the pistil, uniformly small and stout for its length, varies in form of ovary; this is nearly always ovoid but may be oblong-cylindric; the style, while mostly parallel-sided, is occasionally swollen at base; the stigmas, almost universally erect, occasionally spread abruptly above the style; though smaller the stigmas bear a resemblance to those found in *Y. baccata*. Near Kingman, Arizona, in one group of plants (in this group the large flowers just mentioned were found) the inflorescences varied greatly in form; one was long, narrow, tapered at both ends (rather than narrow below and broadened and rounded above); another was fleshy, brittle, with fasciate branchlets and many more or less abnormal flowers of larger size than commonly. Only one specimen in herbaria, *M. E. Jones* 3166 (W 223412), shows floral abnormalities, one flower being 7-parted; in the main the species seems fairly stable. Fruit is enlarged and plump near the base, tapered above; it is characteristically constricted and distorted. In some years it is plentifully produced, in others sparingly; in 1931 scarcely any was found in Arizona but in 1932 in the same region it was abundant and in California also; in 1934 in Arizona and in Nevada most clusters were heavily laden; as noted already much fruit from the 1935 crop was seen in California in the winter of 1935–1936. Since fruit in herbaria usually lack the old floral base the attachment of the filaments at the fruit stage can rarely be studied; Howell 2973 and Ferris 956 show the filaments just united, as commonly; Ferris and Duncan 2222

¹ The pistil of *Y. schidigera* suggests in form, at times noticeably, that of the Joshua-tree, although smaller; and the curiously long, narrow perianth-segments of the latter were approximated in one inflorescence of *Y. schidigera*. The two species sometimes grow side by side and their seasons of bloom occasionally overlap but no plant suggestive of hybrid origin has been found.

show each filament free from those adjacent; *Eastwood 18214* shows some united, others free on the same fruit; in this last specimen the leaf-spine is 2 cm., — unusually long. Sargent in his *Silva* wrote: "The fruit, which is rather sparingly produced, ripens in August and September . . . and in ripening turns from green to a tawny yellow color, and then passes through shades of brownish purple, finally becoming dark dull brown or nearly black; it has a sweet succulent flesh, often half an inch in thickness, and a thin light brown inner coat." Britton and Shafer (*N. Amer. Trees*, 157, fig. 118. 1908) referred to the flesh as "succulent and juicy;" Sudworth (*Forest Trees Pacif. Slope*, 203, fig. 81. 1908) called it "Pulpy, sweetish . . . ripened late in August, or early in September." Of the wood Sargent (*Silva*) wrote: "The wood of a plant from San Diego, California, is soft, spongy, light brown, and difficult to work. The specific gravity of the absolutely dry wood is 0.2724, a cubic foot weighing 16.98 pounds." Sudworth, of the plant's longevity, wrote: "No definite statement can be made concerning the age limit of this yucca, which, however, can hardly be less long-lived than the Joshua Tree. Messrs. C. R. Orcutt and S. B. Parish, who know the tree yuccas from long observation, both inform the writer that the Mohave yucca is an exceedingly persistent but very slow grower in its native habitat, scarcely any change having been perceived in trees under observation for the last twenty-five years."

Sudworth (1927) cited Spanish-dagger, Spanish-bayonet, tree-yucca, Mohave yucca as names in use for this species; elsewhere he suggested that "Since its most extensive and characteristic growth is found on the Mohave Desert, the common name here coined for it [Mohave yucca] seems more appropriate and distinctive than the usual name of 'Spanish Dagger,' which is used for several other Yuccas, some of which occur in the same range." Britton and Shafer gave preference to the common name Mohave yucca.

Dr. Edward Palmer's *Plants Used by the Indians of the United States* (*Amer. Naturalist*, 12: Sept., Oct., 1878) discussed four yucca species; his *Y. baccata* because of the range (comprising New Mexico, Arizona and southern California) included *Y. baccata*, *Y. schidigera* and perhaps *Y. Torreyi* and *Y. Schottii*; these species cannot be differentiated satisfactorily but much of the discussion refers, because of the southern California references, to *Y. schidigera* for *Y. Whipplei* and *Y. brevifolia* are treated separately. Since this article is frequently cited it seems well to quote it here, although the aggregate concept must be remembered. Palmer wrote: ". . . Its fruit is eaten while fresh and in the dry state . . . The bodies of these plants are very fibrous. The Indians and Mexicans when in want of soap cut the stems into slices, beat them into a pulp, and mix them with the water in washing as a substitute for soap, for which it answers finely. The leaves are . . . very fibrous. In order to remove the bast the leaves are first soaked in water, then pounded with a wooden mallet, at the same time occasionally plunged into water to remove the liberated epidermis. Then if not sufficiently clean and white it is returned to the water for a time and again put through the beating process; generally the second course is sufficient. The fibres of the leaves being strong, long and durable are adapted for Indian manufactures, and the savages of Southern California make therefrom excellent horse blankets. All the tribes living in the country where this plant is found, use it to make ropes, twine, nets, hats, hair brushes, shoes, and mattresses. The Diegeno Indians of Southern California have brought the uses of this plant to notice by the various articles they make from its fibres, and sell to white settlers. In preparing a warp for the manufacture of saddle blankets, it is first loosely twisted, then when wanted it receives a firmer twist. If the blanket is to be ornamented, a part of the warp during the first process, is dyed a claret brown, oak bark being used for that purpose . . . This plant so fibrous, and so abundant on land utterly worthless for the growth of anything more

valuable, can be had for the gathering; and as paper materials are scarce, either alone or mixed with straw, would be valuable in the manufacture of that article." See also C. R. Dodge in *U. S. Dept. Agric. Fiber Investigations Report* no. 9, 1897.

YUCCA TORREYI

Yucca Torreyi Shafer in Britton and Shafer, *N. Amer. Trees*, 157, fig. 117 (1908).

Yucca baccata var. *macrocarpa* Torrey in Botany, Emory Report, 221 (1859).

Yucca macrocarpa (Torrey) Merriam in *N. Amer. Fauna*, no. 7, 358 (May 31, 1893), as to name only. — Coville in *Contrib. U. S. Nat. Herb.* 4: 202 (Nov. 29, 1893), as to plants of western Texas. — Trelease in *Rep. Missouri Bot. Gard.* 13: 110, tt. 70, 71, 85, fig. 5, 86, fig. 2, 98, fig. 1 (range map) (1902), in large part. Not *Y. macrocarpa* Engelm. (1881).

SUPPLEMENTARY REFERENCES. Sub *Y. macrocarpa*: Sargent, *Man. Trees N. Amer.* 118, fig. 103 (1905).

Plant 2.5–6 m. in height, commonly with single, little-branched stem, occasionally with several stems; stem covered to base with dead reflexed leaves. Head of leaves longer than broad, constricted below, spreading above, 2.5–3 m. in length, 2–2.5 m. in breadth at widest point, occasionally smaller. Base of mature leaf broader than long, its median length 4–7.5–10 cm., its breadth at insertion 7.5–15 – even 20 cm., at union with blade 2.5–5–7.5 cm. Blade of mature leaf averaging about 1 m. in length but occasionally exceeding 1.5 m., commonly tapered from union with base to apex (rarely a little constricted for about 15 cm. above union with base), straight, rigid for entire length, rarely falcate, thick, more or less scabrous on both surfaces, lenticular to plano-convex near base, elsewhere concavo-convex (the base of concavity rounded to angled), dark yellow-green; leaf-margins thick, blunted, with many detaching fibres; fibres separating early, at first curly, at length straight, tough; apex long-acuminate, thickened, at times triquetrous; spine 0.7–1.2 cm. in length, stiff, sharp, with age blunted. Inflorescence 1–1.3 m. in length overall (scape 15–20 cm. in length, stout, about 7.5 cm. in diameter at base); inflorescence proper commonly narrowed below, spreading near middle or slightly above, with rounded or acute apex (racemose tip short, scarcely exceeding tips of uppermost branchlets), exceeding foliage by $\frac{1}{4}$ – $\frac{1}{2}$ its length, at anthesis densely crowded and extremely heavy, glabrous (rarely slightly pubescent), greenish often tinged with reds and purples; branchlets about 30 or more in number (basal 10–23 cm. in length, central 25–30 cm., uppermost 12–15 cm.), erect-ascending, at times somewhat compressed, ridged; pedicels 2–5 cm. in length, terete or slightly flattened, for most of their length horizontal or erect-ascending, near union with flower decurved, enlarged, obscurely 3-sided, immediately at flower terminating in a very narrow, rounded enlargement; bracts on scape 6–8 in number; those just above basal leaf-like ones 30–37 — even 60 cm. in length, 5–6.5 cm. in breadth at insertion, lower half soft-leathery, upper half leaf-like; uppermost bracts on scape 15–18 cm. in length, 6.5–9 cm. in breadth at insertion, broad-ovate, leathery throughout with short-acuminate to acute, spinescent apex; bracts at base of lower branchlets similar to those on upper scape; those at base of central and uppermost branchlets similar in form but reduced in size, thick-papery rather than leathery, eventually brittle; bracts at base of pedicels narrow-ovate, small, with short-acuminate to acute, hood-shaped apex, of the texture of heavy tissue-paper, soon dry, fragile; flowers campanulate, large, 6.5–8 – even 10 cm. in length, with base (united portion of perianth) conspicuously gibbose (rarely more cup-shaped), waxen, cream colored; perianth-segments variable in form, much thickened (especially those of outer row) and concave in center for entire length, narrowed near base and apex, much the same form in both series, with thickened, hood-shaped, pubescent apex; those of inner row at times slightly shorter, broader and less narrowed at base than those of outer row; filaments 3.2–4 cm. in length, much broadened at extreme base, frequently overlapping (those of inner row attached slightly higher than those of outer row)

but rarely uniting with those adjacent, papillose to short-pubescent, stout, sturdy, their clavate tip $\frac{1}{3}$ – $\frac{1}{4}$ of the entire filament in length, conspicuously swollen, at anthesis erect-ascending or horizontal; anthers 3.2–5 mm. in length, the basal lobes $\frac{1}{3}$ – $\frac{1}{2}$ of entire length; pistil 2.5–3.2 – rarely 4 cm. in length; ovary tapered from base to union with style, 0.7–0.8 – rarely 1.1 cm. in diameter; style 5–8 mm. in length, slender to stoutish, at base truncate or terminating in 3 ill-defined tips; style and stigmas forming a vase-shaped unit (style spreading from union with ovary, stigmas spreading from union with style); stigmas longer than broad, short-emarginate; fruit variable in size and form, commonly 10–14 cm. in length, 3.2–5 cm. in diameter, gradually tapered upward for its major lower portion, for 2.5–5 cm. below tip abruptly narrowed into an acute to short-acuminate apex, as a rule symmetrical, rarely constricted, with primary fissures sharply and deeply cleft on narrowed portion, on enlarged portion broadened into shallow indentations, the intervening lobes depressed along lines of secondary dissepiments; style and stigmas deciduous; perianth and filaments reflexed, often enlarged and hardened at base.

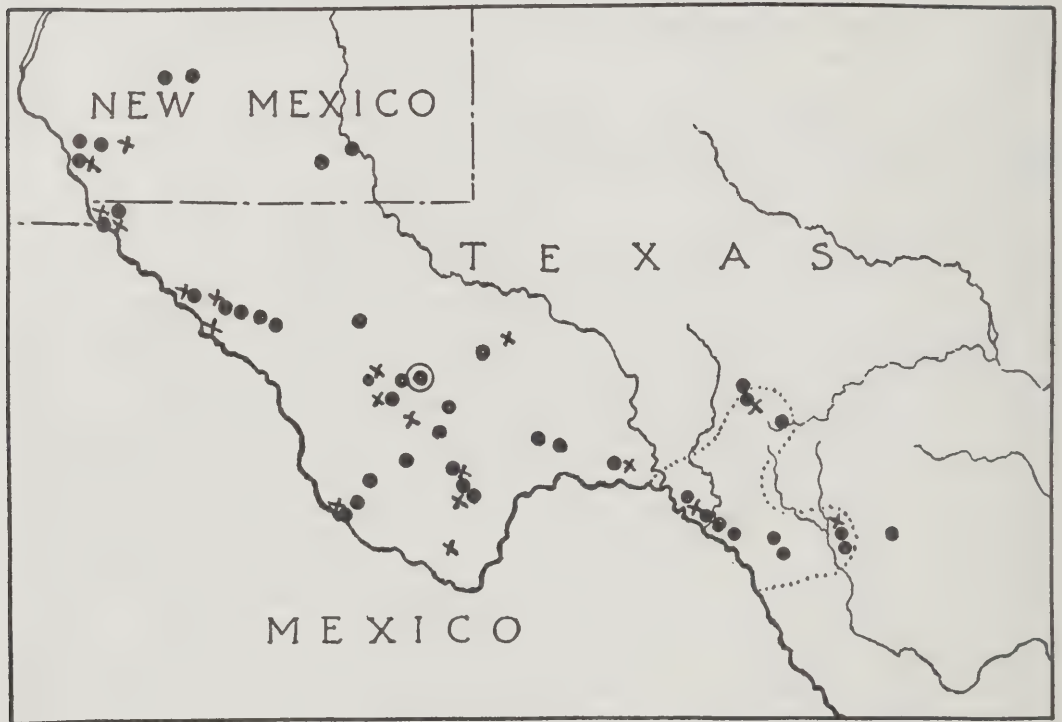
Range. Extending from the Uvalde and Devil's River regions of Texas across the southwestern part of that state and into the mountainous portions of southeastern New Mexico as far west as the environs of the Rio Grande.

¹TEXAS. Medina or Bexar Co.: Between Sabinal and San Antonio, April 2, 1932, *McKelvey* 2596, 2598 (AA). Uvalde Co.: Between Uvalde and Laguna, April 17, 1931, *McKelvey* 1882 (AA). — Mrs. Wynne's ranch, Laguna, on east side of Nueces River, April 1, 1932, *McKelvey* 2592, 2593, 2594 (AA). Kinney Co.: Spofford, cultivated, March 21, 1900, *W. Trelease* 162 (M). — Fort Clark, March 15, 1893, *E. A. Mearns* 1290 (UC) (N) (S) (W). — Spofford, May 8–9, 1904, *D. Griffiths* 6279 (W). Val Verde Co.: "Expedition from Western Texas to El Paso, New Mexico, May–October, 1849, *C. Wright* 687" [=688, see text] (G) (UC) (W). — Vicinity of Devil's River, Oct. 16, 1913, *J. N. Rose* and *W. R. Fitch* 18001 (W). — About 12 miles northeast of Del Rio on road to Brackettville, March 30, 1931, *McKelvey* 2591 (AA). — Just west of Devil's River, March 29, 1932, *McKelvey* 2589, 2590; May 22, 1932, *McKelvey* 2817, 2817A (AA). — Between Devil's River and Pecos River, May 22, 1932, *McKelvey* 2821, 2822 (AA). — Between Langtry and Sanderson, April 21, 1931, *McKelvey* 1944, 1945; March 29, 1932, *McKelvey* 2586, 2587 (AA). Sutton Co.: Upper Valley of Llano, from 3–6 m. high, May, 1884, *J. Reverchon* 1604 (M). — 6 miles south of Sonora, April 9, 1932, *McKelvey* 2622, 2626, 2627 (AA). — Texas Agricultural Experiment Station south of Sonora, April 9, 1932, *McKelvey* 2623 (AA). Terrell Co.: Feodora, dry rocky plains near, April 26, 1928, *E. J. Palmer* (AA). — West of Sanderson, May 22, 1932, *McKelvey* 2823 (AA). Pecos Co.: 15 miles southwest of Fort Stockton, April 10, 1932, *McKelvey* 2632, 2633–2 (AA). Brewster Co.: Marathon, May, 1901, *V. Bailey* (W). — Marathon, March 5, 1910, *Lloyd* (M). — Between Hovey and Alpine, April 10, 1932, *McKelvey* 2634, 2634A (AA). — Between Alpine and Terlingua, April 11, 1932, *McKelvey* 2637, 2638 (photos. 121–2, 3) (AA). — Near Persimmon Gap, road from Marathon to Boquillas, April 24, 1931, *McKelvey* 1964, 1965 (AA). — South of Persimmon Gap, March 28, 1932, *McKelvey* 2577, 2578, 2579 (AA). — North of Persimmon Gap, May 24, 1932, *McKelvey* 2835, 2836 (AA). Presidio Co.: Marfa to Shafter, Aug. 7, 1900, *W. Trelease* 404, 405 (2 sheets; M). — North of Shafter, March 26, 1932, *McKelvey* 2566, 2567, 2570; south of Shafter, March 26, 1932, *McKelvey* 2563 (AA). — Five miles north of Presidio, April 26, 1931, *McKelvey* 2012, 2013, 2015, 2016, 2018 (photos. 101–7, 8) (AA). — Presidio, Aug. 9, 1900, *W. Trelease* 406 (2 sheets; M). Jeff Davis Co.: Davis Mts., Aug. 13, 1902, *V. Bailey* 500 (W). — Barrel Springs Ranch, Davis Mts., July 6, 1921, *R. S. Ferris* and *C. D. Duncan* 2677 (S) (CA) (N). — Alpine to Fort Davis, March 27, 1932, *McKelvey* 2572, 2573–1, 2 (AA). — Between Fort Davis and Limpia Creek, May 23, 1932, *McKelvey* 2829 (AA). — Near Limpia Creek, April 22, 1931, *McKelvey* 1956 (photo. 98–12) (AA; type of *Y. macrocarpa* [Torr.] Merriam); March 27, 1932, *McKelvey* 2571 (AA); May 23, 1932, *McKelvey* 2830, 2831 (AA). — Limpia Canyon, June 6, 1902, *Bray* (UT). Culberson Co.: Kent, April 18, 1931, *M. E. Jones* 28402 (PO) (UC; excluding 2 flowers). Hudspeth Co.: Between Van Horn and Sierra Blanca, May 25, 1932, *McKelvey* 2848 (AA). — 9 miles west of Van Horn, April 16, 1932, *McKelvey* 2654 (AA). — Eagle Flat, April 15, 1932, *McKelvey* 2651 (AA). — Sierra Blanca, Sept., 1894, *C. S. Sargent* (AA). — Sierra Blanca, Aug. 11, 1900, *W. Trelease* 407 (M); April 7, 1902, *W. Trelease* (2 sheets; M). — Between Sierra Blanca and McNary,

¹ Typical plant and form are separated mainly upon difference in size of flower; specimens lacking flowers are cited here rather than under the variety.

April 16, 1932, *McKelvey* 2655-1, 2 (AA). El Paso Co.: El Paso, Aug., 1910, *E. Stearns* (M). — Vicinity of El Paso, Feb. 26, 1910, *J. N. Rose*, *P. C. Standley* and *P. G. Russell* 12282 (N). — El Paso, Franklin Mts., 1-3 m., *R. S. Ferris* and *C. D. Duncan* 2438 (CA) (S) (N; excluding capsular fruit). — El Paso, March, 1881, *G. R. Vasey* (N) (2 sheets; W); 1881, *G. R. Vasey* (2 sheets; W). — El Paso, Franklin Mts., April 10, 1932, *E. Whitehouse* (2 sheets; UT); May 2, 1932, *E. Whitehouse* (UT).

NEW MEXICO. Otero Co.: Guadalupe Mts., 1-1.3 m. high, Sept. 4, 1902, *V. Bailey* 503 (W). — Sacramento Mts., Alamagordo, alt. 1400 m., dry canyon, May 25, 1902, *J. A. G. Rehn* and *H. L. Viereck* (AA) (P; dated both "V. 8. 02," and "April 24, 1902;" as to leaves only). Dona Ana Co.: In the Organ Mts., May 20, 1900, *E. O. Wooton* (UC). — On the mesa west of the Organ Mts., April 13, 1902, *E. O. Wooton* (PO) (UC). — Mesilla Park, June 9, 1900, *E. O. Wooton* (M). — Tortugas Mt., Feb. 28, 1910, *J. N. Rose*, *P. C. Standley* and *P. G. Russell* 12258 (N).



MAP 7. Ranges of *YUCCA TORREYI* (●) and *f. PARVIFLORA* (×).

The plants collected in the course of the United States and Mexican Boundary Survey were determined in 1859 by John Torrey; after describing his acaulescent species *Y. baccata* he wrote: "On the plains of western Texas, near the Limpio, and in the vicinity of Presidio del Norte, Dr. Bigelow found a yucca 10-15 feet high, with leaves almost exactly like those of *Y. baccata*, but the fruit is longer, though not greater in diameter, and the pulp is thicker. It may, until better known, be regarded as a variety (*macrocarpa*) of that species." Although there do not appear to be any Bigelow collections from these regions Torrey's variety has been long accepted as the plant now called *Y. Torreyi*.

In 1893 Coville and Merriam, botanists of the Death Valley Expedition, separated the acaulescent *Y. baccata* from the arborescent yuccas (which Engelmann had considered to be a form of that species) and for the latter adopted Torrey's varietal name *macrocarpa*, raising it to specific rank; Coville made the qualification that the tree yucca of the Mohave

Desert region [long called *Y. mohavensis* but here renamed *Y. schidigera*] might possibly be distinct from the one of western Texas with which he was unfamiliar; the Texan plant was later identified with the species under discussion. (The authorship is usually cited *Y. macrocarpa* (Torr.) Coville; actually Merriam published the name 6 months earlier than Coville.)

In 1895 Sargent misapplied the name *Y. macrocarpa* (Torr.) Merriam to a plant growing at Sierra Blanca, Texas, and the next year published its description in his *Silva*, together with a Faxon plate; the plant of the Mohave Desert he named *Y. mohavensis*. Trelease in 1902, after a visit to Presidio (one of the two regions cited by Bigelow and by Torrey) pointed out that the Sierra Blanca plant did not grow there and consequently could not be Torrey's variety *macrocarpa*; Trelease placed Sargent's plant in a new genus, *Samuela*, with specific name *Faxoniana*, in tribute to the artist of the *Silva* plate. For the arborescent yucca which he found growing about Presidio Trelease continued to use Torrey's name *macrocarpa* which Merriam and Coville had raised to specific rank.

In 1908 Shafer pointed out that the name *macrocarpa* had been used earlier, in 1881, by Engelmann for another species (*Y. Schottii* Engelm.) and was not tenable; therefore he gave the plant under discussion the new name *Y. Torreyi* by which it is now known.

In 1871 Engelmann determined the yuccas collected on the expedition which explored the 40th Parallel (Botany, King Report) and included in his concept of *Y. baccata* both acaulescent and arborescent plants, noting that "Northward a low plant it becomes a tree farther south;" he cited no specimens but named a wide range, — "From New Mexico and S. Colorado through S. Utah, to Arizona, California and Mexico." In 1873 he distinguished between a short-stemmed or stemless *Y. baccata* forma *genuina* [the true *Y. baccata*] with, among other characters, large, narrow perianth-segments, and an arborescent variety β *australis*, with smaller, ovate perianth-segments and shorter style; he further noted that "the southern or Mexican form of this species [*Y. baccata*] is principally distinguished by its smaller flowers . . . with . . . segments $1\frac{1}{4}$ – $1\frac{3}{4}$ inches long . . ." Engelmann cited many specimens, all available now; from their study we know that, of them all, only some of the Mexican specimens (those collected by Wislizenus in Chihuahua) represent *Y. Torreyi*, and in its small-flowered form; these Wislizenus collections are discussed under *Y. Torreyi* f. *parviflora* here distinguished. Trelease's specific description of *Y. macrocarpa* (Torr.) Merriam noted the flowers as "mostly more globose and smaller [than in *Y. baccata*], (the perianth segments usually about 40 mm. long)." His visit to the region of Presidio was made when the species was not in flower and he only mentions the bloom in the phrase just quoted; his concept of the flowers is also referable to *Y. Torreyi* f. *parviflora*. Torrey had no information as to the flowers of his variety *macrocarpa* and did not mention these although Trelease (1902) stated that "the flowers and fruit [of *Y. macrocarpa* (Torr.) Merriam] are as described by Dr. Torrey . . ."

Had it not been for Torrey's reference to two regions, "near the Limpio, and in the vicinity of Presidio del Norte," the writer would have selected (since there are no Bigelow specimens from either locality) the Wislizenus collection to stand for a type for it formed the basis of both Engelmann's and Trelease's concept of the species. The first locality cited by Torrey is Limpia Creek which rises in the Davis Mts. and runs east to the north of Fort Davis, Jeff Davis Co., Texas; apart from a Bray specimen from Limpia Canyon, collected in 1902, and the author's own there are none from the Limpia Creek region although there are several from the Davis Mts. The Report (p. 85) refers to Presidio del Norte as Mexican; whether the present town of Presidio on the north side of the Rio Grande existed in Torrey's day has not been learned by the writer; Trelease's collections (foliage only) made in 1902, and the writer's, represent all the material from the region

of Presidio. Torrey's description was meagre but, taken in conjunction with the localities, there can be no doubt of the species which Bigelow had observed for no comparable plant grows in either region; the writer has full material from both localities having visited them more than once. Since Torrey cited "near the Limpio" first and since it has been named as type locality by Wootton and Standley (Contrib. U. S. Nat. Herb. **19**: 137. 1915) and by Standley (ibid **23**: 94. 1920) it has seemed reasonable to consider it such; and, since no earlier comprehensive material from the region exists, the writer has selected one of her own collections (*McKelvey 1956*; herb. Arnold Arboretum) to serve as type of *Y. macrocarpa* (Torr.) Merriam; this consists of flowers, inflorescence parts, foliage, old fruit and seed, collected April 22, 1931; from the same and adjacent plants fruit (*McKelvey 2830, 2831*) was collected May 2, 1932, and a flower-bud (*McKelvey 2571*) March 27, 1932; the writer's photograph 98-12 (pl. LII) shows the type plant; her 98-8 (pl. LIII) was taken in the same region. Throughout its range there exist two forms of *Y. Torreyi*, one small-flowered, one large-flowered; the latter predominates in the Limpia Creek region and is represented in the type; it is, moreover, the common form throughout the plant's range. The Wislizenus collection is an excellent example of the small-flowered form and is selected as type of that form, and named *parviflora*.

Throughout its range, with the exception of certain more caespitose plants later mentioned, *Y. Torreyi* is of much the same habit, producing one or at times two or three stems of unequal height and covered to the ground with dried, reflexed leaves, the plant, except when young, untidy and ragged in appearance; a photograph taken by Vernon Bailey near Marathon, Texas, in 1901, shows a 15 ft. plant with the lower portion of its stem denuded of leaves; it is rare, however, to find the bark exposed; plants are most often unbranched but a few forkings may occur. The heads of leaves are longer than broad, on young specimens especially often extremely elongated; the leaves are mainly erect-ascending so that the head appears constricted below and spreading above, widest at the top. The long, little-broadened leaf-blade is rigid, concave, tapered, and is tipped with a short but inflexible spine which should be treated with respect; on young leaves the base is scarcely to be distinguished from the blade; on mature leaves, however, its breadth, at times, is very great in comparison to its median length. The inflorescences, with short scape, are not raised for their full length above the foliage (at times are nearly buried), and are well protected against cattle¹; they are often too crowded with flowers for real beauty; the top of the flowering portion is rounded to acute, depending upon the length of the racemose tip; the bracts are highly colored and especially conspicuous at the bud-stage; they seem to be slightly broader than those of *Y. Treculeana*; while the inflorescence is as a rule glabrous it is not uncommon to find pubescent pedicels, — those of *Wislizenus 221* are an example; the pedicel is generally curved, enlarged and obscurely 3-sided as it approaches the flower and at point of attachment thereto terminates in a tiny, narrow, molding-like ring; while sometimes found in other species this termination is very common on the pedicels of *Y. Torreyi*. In both large and small flowers most characters are very similar; the perianth-segments are waxen, extremely concave, much thickened in the center from base to hood-shaped apex and where thickened are brittle and easily snapped; this thickening, especially pronounced at the base of the segments, produces the extremely gibbose base characterizing most flowers of this species; rarely, when this thickening is

¹ Vernon Bailey in his "Biological Survey of Texas" (N. Amer. Fauna, no. 25, 66. 1905) writes: "At Langtry, in March and April, 1903, Gaut reported deer as 'very plentiful a few years ago,' and said: 'I visited the localities where old hunters claimed to have seen large numbers a few years back, and it is safe to say the large numbers are not there now. A young buck and a very large doe were seen. The heads of small rough canyons seem to be their favorite feeding grounds, and at this time of year they seem to feed to a great extent on the blossoms of *Yucca macrocarpa* [= *Y. Torreyi*] and *Dasyliirion texanum*.'"

reduced, the base is suggestive of the short, cup-shaped one found in the *Baccatae* series, or may be even somewhat saucer-shaped; while such floral bases are more common in the small than in the large flowers they are not confined to one or the other; the segments vary greatly in shape, some in proportion to length extremely narrow, others broad; the flowers of the typical plant range from 6.5–10 cm. in length but are commonly 7.5–8.2 cm.; in shape and size they often suggest those of the *Baccatae* series and it is not strange that *Y. baccata* and *Y. Torreyi* should often have been confused; the flowers of the form vary from 4.5–5.7 cm. in length, averaging the last; the most distinctive floral part in *Y. Torreyi* is the pistil and its size does not vary with the size of the corolla; compared with that found in the *Baccatae* series (where it is 4.5–8.2 cm. in length) it is always small, (2.5–3.2 to rarely 4 cm. in length) and in form it varies but little; the ovary tapers from base to style and lacks conspicuous shoulders and the style and stigmas, considered as one, are vase-shaped, — the first spreading upward from union with the ovary, the last from union with the style to the tips; looked at from above each stigma appears elongated and much the same breadth from base to apex; this narrow form is probably explained by the fact that the emargination is shorter than the stigma and consequently allows little spreading of the two lobes of each stigma; a deeply cleft stigma with, in consequence, more spreading lobes is rarely, though occasionally, found; the filaments are finely papillose, sturdy, even rigid in appearance, with a conspicuous clavate tip; each is broadened near its point of attachment but only rarely unites with those adjacent although (since those of the inner row are attached a trifle higher than those of the outer) they frequently overlap. Fruit may be plentifully produced, 100 individuals to one cluster not uncommon; the number upon one inflorescence may be more easily counted than in *Y. Treculeana* since the old bracts and corollas are not so persistent as in that species; the individual is variable in form, occasionally short and stout, more often long and rather slender; it averages considerably larger, in length and in diameter, than that of other species of the same series but the writer has never seen it of the extremely large size found in *Y. baccata*, certainly not as to diameter; that it was thought to be larger and consequently distinguished by Torrey as *Y. baccata* var. *macrocarpa*, was probably due to the fact that the first collected fruits of *Y. baccata* (from Hurrah Creek, New Mexico, and elsewhere) were extremely small, not representative of the species; at first green, the fruit becomes purplish and, when fully ripe, is said to be almost black; the writer has not seen it at this advanced stage; examination of the old floral base of the fruit shows, more clearly than at the flower stage, the separate attachment of the filaments; style and stigmas are not persistent and are rarely found on fruit of good size; a normally developed fruit (and constriction in that of *Y. Torreyi* is rare) preserves fairly closely the form of the ovary at the flower-stage.

Yucca Torreyi grows, not continuously but in belts of scattered plants, upon open desert flats and mountain foothills, and at elevations of 300–1700 m. The writer found it in Texas from Uvalde Co. west, northwest and southwest to El Paso where it was common in the Franklin Mts. More specifically it extended from Uvalde Co. northwest into Sutton, Reagan, Upton and Ector Cos., thence south and west through Pecos, Reeves and Jeff Davis Cos.; it was found in seven of the counties bounded on the south by the Rio Grande or in Kinney, Val Verde, Terrell, Brewster, Presidio, Culberson and Hudspeth. It may extend further north but was disappearing north of the Pecos River and was not found in Martin, Howard or Dawson Cos., nor still farther north in the Panhandle (a region of capsular yuccas), nor thence further east to the center of the state.

The writer has not traveled in the southeastern part of New Mexico lying east of the Rio Grande (the portion included in Roosevelt, Lea, Chaves, Eddy, Lincoln and western Dona Ana Cos.); herbarium material shows *Y. Torreyi* only from Dona Ana Co. (from

the region of Las Cruces and Mesilla, from the Organ Mts. and from Tortugas Mt.) and from Otero Co. (from the Guadalupe Mts. and from Alamogordo in the Sacramento Mts.); a photograph (*Vernon Bailey 458*) taken at Carlsbad places it in Eddy Co. also. These are the only New Mexican records known to the writer; she has been in most of the other counties of the state without finding *Y. Torreyi* and believes that the plant is confined in New Mexico to the southeastern portion, not crossing, or certainly not extending any great distance west of, the Rio Grande; its New Mexican occurrence appears to be only an extension northward from its range in western Texas; for in both these states it follows the mountainous regions lying west of the Pecos River and in Texas certainly, and it would seem in New Mexico, rapidly disappears in the Staked Plains or Llano Estacado. Trelease's range map (t. 98, fig. 1) does not show *Y. Torreyi* in this southeastern New Mexico region except along the Rio Grande; but from that river it is shown extending westward into the southeastern corner of Arizona. As noted elsewhere the writer believes that the use of the name "*Y. macrocarpa*" (without citation of author) for plants indigenous to the Chiricahua Mts. and to other parts of southeastern Arizona, has created the misconception that *Y. Torreyi* extends so far west; *Y. Schottii* Engelm. was first named *Y. macrocarpa* by Engelm. and many specimens of that species bear the older name; also members of the *Baccatae* series from southeastern Arizona and adjacent southwestern New Mexico have been misdetermined and similarly labelled. *Yucca Torreyi* (to judge by what has been observed in the field and by herbarium material) does not appear to come, in New Mexico, within 100–150 miles of the Arizona line.

Wootton and Standley (Contrib. U. S. Nat. Herb. **19**: 137. 1915) name Silver City and Fort Bayard among New Mexican localities for "*Y. macrocarpa* (Torr.) Engelm." (This citation of Engelm. as author is merely a slip, corrected by Standley in his *Trees and Shrubs of Mexico*.) The writer has not found *Y. Torreyi* in either of these regions; nor has she found herbarium specimens from the Silver City region which were indistinguishable with that species; all showed the insertion of filaments and long pistil characterizing the *Baccatae* series.

In the region of Limpia Creek, the type locality, *Y. Torreyi* grows at an elevation of about 1500 m. and is scattered for the most part over low, rocky foothills, appearing to avoid the sandy regions between; possibly it has been eliminated therefrom as the demand for arable lands about Fort Davis has increased; the rock of the region is igneous, felsitic lava. Most plants were about 2.5 m. in height or, with the inflorescence, 3–3.5 m.; only one was seen approaching 6 m.; most produced one stem and one head of leaves; a few were sparingly branched a few feet above the ground; what appeared to be one head of leaves at times proved to be composed of several as was made evident by old inflorescence stalks still persistent in the lower portions of the head, rather than in the terminal cluster of leaves. The region was visited several times: on April 23, 1931, plants were in fine flower; on March 27, 1932, in bud; on May 23, 1932, fruit was plentiful and well-developed, the clusters so heavy that they drooped outward from the base. The average inflorescence was about 1 m. in length, exceedingly heavy, fleshy, brittle and closely packed with flowers; the bracts were large, the lower ones very thick and leathery, those above more papery, and their varying shades of reds and purples contrasted strikingly with the expanding cream-colored flowers although these, especially when in bud, were often similarly colored; transported indoors the flowers had a slightly unpleasant odor not noticeable in the open; the flowers of the region were uniformly large although further south, between Alpine and Fort Davis, the small-flowered form was collected; the only floral abnormalities noted in this section of the country were present on this plant; flowers were occasionally found in which the central thickening of the sepals flattened out

somewhat near the base, the base of the flower (or the united portion of the perianth) then appearing slightly more cup-shaped than gibbose; such a base was rare however; the pistil in all instances was of the characteristic form which distinguishes this yucca from all others of the southwest.

The arid, desert region just north of Presidio was visited twice and *Y. Torreyi* was more plentiful there than near the Limpia; the elevation is about 1400 m.; the plants did not differ greatly in appearance from those at the type locality but averaged taller (specimens of 6 m. not uncommon) and were less handsome, being often weather-beaten and ragged (see pls. LIV, LV); they may merely average older but doubtless have more to contend with in temperature and soil; several stems were not unusual here. On April 26, 1931, most were in fine flower, the large heavy inflorescences drooping outward from among the leaves. On March 26, 1932, practically all inflorescences had been ruined, unseasonable cold having destroyed not only the bracts but the flower-buds which they protected; the cold must have hung longer over these flats for a little further north and a little higher, near Shafter, the injury was not so universal and flowers were more advanced; this was one of few times when cold injury was noted in any stand of yuccas. Both large and small flowers were seen, the first more common; had Trelease's visit to the region been made when the species was in bloom he would doubtless have commented upon the two floral forms which, at intervals from Marfa to Presidio, grow in close proximity to each other and are distinguishable from afar, — the inflorescences of the form somewhat muddy and sordid in color tone, those of the typical plant of greater purity and more conspicuous.

Throughout the region of Texas known as the Big, or Great Bend (a more or less triangular area with apex pointing south and outlined by the Rio Grande and with base to the north roughly indicated by the Southern Pacific Railroad) *Y. Torreyi* abounds and, for the most part, is very similar in appearance. However, in Brewster Co., south of Persimmon Gap in the Santiago Mts. (along the road from Marathon to Boquillas) many plants were of an unusual habit, forming large, untidy, confused clumps and producing numerous short to fairly long stems covered with dead, reflexed-spreading leaves; the pale, blue-green leaves were often falcate, twisted, extremely long and narrow; the heads of leaves were large and elongated, as in *Y. Torreyi*. On the writer's visits to the region bloom was rare on these plants although on *Y. Torreyi* it was plentiful; the only two inflorescences found had produced in one instance (*McKelvey* 2578) large flowers which were variously abnormal, in the other (*McKelvey* 2580) small flowers; both inflorescences were few-branched but did not differ in any marked respect from those of *Y. Torreyi*. In general appearance these plants suggested the extremely vigorous *Y. baccata* var. *vespertina* found in the Acquarius Mts. of northwestern Arizona and southward and which flowered sparingly; as these appeared to be merely a vegetative form of *Y. baccata* var. *vespertina*, so here we seem to have a vegetative, ecological form of *Y. Torreyi*, — the plants "run to leaf;" in both regions soil and moisture conditions were extremely poor. While more prevalent in the Big Bend region than elsewhere, similar plants were noted between Marathon and Sanderson, between Hovey and Alpine, and from Alpine towards Terlingua, — these regions (as distance is reckoned in the southwest) not far removed from each other.

Yucca Torreyi grows in association with *Y. baccata* but, even lacking flowers, the two may be distinguished in the field; the writer has never found a hybrid between these species but, even in regions where they are not growing in association, she has noted characters suggesting a relationship though perhaps remote (see pp. 42, 43). In *Y. confinis* also were found suggestions of a relationship to *Y. Torreyi* (see p. 51). In certain regions *Y. Torreyi* grows with the capsular species *Y. elata*, *Y. rostrata*, *Y. Thompsoniana* and perhaps others

but the plants of these different sections do not seem to have had any influence upon each other.

Under *Y. Faxoniana* mention has been made of a possible hybrid between that species (which seemed to be the major influence) and *Y. Torreyi*. The last also grows in association with *Y. carnerosana* and *McKelvey 2646*, collected April 12, 1932, south of Persimmon Gap in the Santiago Mts., Brewster Co., along the road to Boquillas, would seem to represent a hybrid of these species. Till the flowers were closely examined the plant was thought to be *Y. Torreyi* for in habit and foliage it resembled that species; the flowers were cream-color (in the *Faxonianae* series a pure white), large (8.25 cm. in length), the segments long, narrow, much thickened in the center from base to apex and united into the very gibbose base associated with *Y. Torreyi*. But the pistil was not characteristic of either species, in size closest to that of *Y. Torreyi*, in form of parts nearest to that of *Y. carnerosana*; most important, many of the filaments, though not all, were attached in the manner peculiar to the *Faxonianae* series and indicated that *Y. carnerosana* had had a part in the plant's origin. The flowers showed structural abnormalities. This unusual attachment of filaments was found in flowers of one other plant of *Y. Torreyi* (*McKelvey 2642*) collected April 13, 1932, between Alpine and Terlingua; *Y. carnerosana* was not seen between these points but the region is not far from its known range; some of these flowers were also abnormal in structure.

***Yucca Torreyi* forma *parviflora*,¹ forma nov.**

Yucca baccata Torrey sensu Engelm. in S. Watson, Botany, King Report, 496 (1871), as to Mexican plants; in Trans. Acad. Sci. St. Louis, **3: 44** (1873), as to the Wislizenus Mexican specimens. "*Y[ucca] crassifila* Engelm. in sched. 1848" Engelm. in Trans. Acad. Sci. St. Louis, **3: 44** (1873), as a synonym of *Y. baccata*.

Yucca baccata var. *β. australis* Engelm. in Trans. Acad. Sci. St. Louis, **3: 44** (1873), as to the Wislizenus Mexican specimens, not the type of *Y. australis* (Engelm.) Trelease.

Yucca macrocarpa sensu Trelease in Rep. Missouri Bot. Gard. **13: 110** (1902), as to flowers.

Similar in habit, foliage and form of inflorescence to typical plant. Inflorescence few-branched and soon ligneous. Flowers globose, small, 4–6 cm. in length, greenish cream, much colored with reds and purples at anthesis, the color effect of the cluster somewhat sordid.

Range. Although less common, found practically throughout the range of the typical plant. For range map see p. 106.

TEXAS. Uvalde Co.: Mrs. Wynne's ranch, Laguna, east of Nueces River, April 1, 1932, *McKelvey 2595* (AA). Val Verde Co.: Between Comstock and Devil's River, March 29, 1932, *McKelvey 2588* (AA). — Between Sanderson and Langtry, March 29, 1932, *McKelvey 2583, 2584, 2585* (AA). Sutton Co.: Agricultural Experiment Station, south of Sonora, April 9, 1932, *McKelvey 2624* (AA). Pecos Co.: About 5 miles northeast of Fort Stockton, April 10, 1932, *McKelvey 2633-1* (AA). Brewster Co.: Chisos Mts., Nov. 22–24, 1922, *H. A. Pilsbry* (P.). — North of Persimmon Gap, road from Marathon to Boquillas, March 28, 1932, *McKelvey 2575*; south of Persimmon Gap, *McKelvey 2580, 2581* (AA). — Between Hovey and Alpine, April 10, 1932, *McKelvey 2635* (AA). Presidio Co.: About 5 miles north of Presidio, April 26, 1931, *McKelvey 2014* (AA). Jeff Davis Co.: Davis Mts., near Fort Davis, rocky ground, foothills, April, 1928, *L. T. Murray 12* (AA). — Between Alpine and Fort Davis, March 27, 1932, *McKelvey 2574* (AA). Hudspeth Co.: Sierra Blanca, April 17, 1931, *M. E. Jones 28397* (PO) (M); April 10, 1930, *M. E. Jones 25971* (M) (PO). — Indian Hot Springs, April 30, 1930, *M. E. Jones 25970* (PO; in part) (M; in part). — Sierra Blanca, April 15, 1932, *McKelvey 2649* (AA). — Between Sierra Blanca and McNary, April 16, 1932,

¹ Habitu, inflorescentia, foliis, fructu plantae typicae similis, sed differt floribus globosis minoribus 4–6 cm. longis albidis viridis – flavidis et sub anthesi colore rubro et purpureo suffusis et inflorescentia pauci-ramosa et mox lignescente.

McKelvey 2655-3 (AA). El Paso Co.: Mountains near Frontera, 2.5-3 m. high, March 19, 1852, Bigelow (N) (M). — El Paso, April, 1884, M. E. Jones (PO); April 22, 1884, M. E. Jones (W).

NEW MEXICO. Dona Ana Co.: Tortugas Mt., southeast of Las Cruces, alt. 1300 m., April 28, 1895, E. O. Wooton (W). — Mesa near Las Cruces, April 10, 1893, E. O. Wooton (W) (M; Wooton note attached).

MEXICO. Chihuahua: Between El Paso and Chihuahua, fruit edible, thick; seeds bitter; tree about 2-2.5 m. high, August, 1846, A. Wislizenus 221 (6 sheets; M; type). — Chihuahua, Wislizenus (M). — San Pablo, south of Chihuahua, fruit dry, not edible, 'Palmilla,' 3 m. high, April 8, 1847, A. Wislizenus 243 (2 sheets; M).

When describing *Y. baccata* in 1873 Engelm. cited many specimens and named a wide range; his forma *genuina* comprised not only the true *Y. baccata* but also *Y. schidigera*; his variety *β. australis* which he calls "the southern or Mexican form . . . distinguished by its smaller flowers . . ." was based upon Mexican collections of Wislizenus (Chihuahua), Thurber (Parras) and Gregg (Saltillo); the last two localities lie far south of the known range of *Y. Torreyi* and the Thurber and Gregg collections have been referred by Trelease to the species for which he took up Engelm.'s name *australis*; the writer has not traveled in Mexico and accepts Trelease's determination since he went there to study these plants; these collections are of foliage and fruit, no flowers; of the Chihuahua material Trelease wrote: "Specimens in the Engelm. Herbarium, collected by Dr. Wislizenus between El Paso and Chihuahua, show that to this extent the *Y. baccata australis*¹ of Engelm. included this species [*Y. macrocarpa* (Torr.) Merriam] . . ."

The size of the flowers which Engelm. considered typical of the more southern, arborescent plant is not made clear in the paragraph following his citation of specimens of *Y. baccata*; this paragraph, if contrasted in its entirety with the next (which deals with the variety *australis*) would indicate that large flowers, with segments 6.5-8.2 cm. in length, are typical of the acaulescent *Y. baccata* and also of some arborescent plants "8 or 10 feet high . . ." Until the specimens cited by Engelm. are examined one might think, therefore, that he included in his forma *genuina* both the true *Y. baccata* and the large-flowered form of *Y. Torreyi*, — for its perianth is of much the dimensions mentioned, those of true *Y. baccata* often larger. Study of the paragraph shows, however, that its first part is applicable to the species and variety as a whole and that, beginning with "The panicle of the stemless form . . .", Engelm. began his discussion of the forma *genuina* in particular and should, for clarity, have begun a new paragraph.

Wislizenus' main collection, no. 221, was made August, 1846, "between El Paso and Chihuahua;" it forms part of the Engelm. Herbarium. No precise locality is given but the date, by reference to the "Memoirs," may be narrowed down to August 15-24, the dates of departure from El Paso and arrival at Chihuahua. The collection (6 sheets) consists of foliage, well-pressed flowers, the inflorescence, and seed; the flowers all represent the small-flowered form of the species under discussion. The region traveled by Wislizenus apparently served as a basis for the Mexican range outlined on Trelease's range map (t. 98, fig. 1). Also at St. Louis is some additional Wislizenus material: a specimen from San Pablo (a little southwest of Chihuahua), April 8, 1847, the flowers also small; a sheet of small flowers from Chihuahua without date or collector's number; on this Engelm. noted "Unknown at present whether these flowers belong to *Yucca crassifila* or to some other species." In 1873 Engelm. cited "*Y. crassifila*, Engelm. in sched. 1848" as a

¹ Trelease founded the binomial *Y. australis* (Engelm.) Trelease upon *Y. baccata* var. *β. australis* Engelm., considering the Thurber and Gregg collections as typical. The Wislizenus specimens he referred to *Y. macrocarpa* as mentioned above. The "*Y. baccata australis* Havard" which he cited as a synonym is merely a misdetermination of plants referable to this species; at first glance the citation is confusing.

synonym of *Y. baccata*. This name appears on *Wislizenus* 221; since this collection represents the form under discussion the name is referred to *Y. Torreyi* f. *parviflora*.

Since Wislizenus first collected the small-flowered form of *Y. Torreyi* and since his collection no. 221 from between El Paso and Chihuahua, Mexico, formed the basis of both Engelmänn's and Trelease's concept of the plant now called *Y. Torreyi*, and since it represents in all respects the form as here understood, it has seemed fitting to select it as type of *Y. Torreyi* f. *parviflora*; the material is unusually fine and complete in comparison with most yucca collections. The flowers of the writer's specimen (*McKelvey* 2585) from between Sanderson and Langtry, Val Verde Co., Texas, are very similar to those of the type.

The flowers distinguishing this form are smaller than those of the typical plant, varying from 4.5–5.7 cm. in length; basically a greenish yellow color, they are usually tinged, even when fully expanded, with dark shades of reds and purples, the effect of the cluster rather sordid. The base of the flower (or united portion of the perianth) shows more tendency to become saucer-shaped in the form than in the typical plant since the corolla-segments, smaller, are often less thickened along their central length; the inflorescences too seem to be fewer-branched and sooner ligneous although this is not universally true; no distinguishing characters have been found in the habit, foliage or fruit which in both forms are very similar.

Yucca Torreyi f. *parviflora* occurs throughout the range of the species. The writer has collected it in Texas in Uvalde, Val Verde, Sutton, Pecos, Brewster, Presidio, Jeff Davis and Hudspeth Cos. She does not recall seeing *Y. Torreyi* in New Mexico but both forms must occur there for in a note to Trelease, who seems to have asked for information about the flowers, Wooton wrote on June 3, 1900: "It is difficult to tell much about this sp[ecies] from flowers alone since they are exceedingly variable in size and in shape of perianth-segments;" his specimen (M 140633), to which this note is attached, is of small flowers, and came from Las Cruces, Dona Ana Co.; Wooton also collected similar ones on Tortugas Mt., southeast of Las Cruces. From Texas the form is represented, in addition to the writer's collections, by material from Brewster Co. (*Pilsbry*), from Hudspeth and El Paso Cos. (*Jones*) (*Bigelow*); as to the last Bigelow, in March, 1852, collected flowers of this form at Frontera, a few miles south of El Paso, where a meteorological survey was kept for two years by Chandler of the United States — Mexican Boundary expedition; the plant's height was 2.5–3 m. From Mexico we have the Wislizenus specimens.

* * * * *

For the greater part of its range which centers in the Big Bend region of Texas, *Y. Torreyi* alone represents the *Treculeanae* series. Trelease referred to its range in Texas as "the vicinity of Presidio," and his range map (t. 98, fig. 1) confined it in the east to that region. *Yucca Treculeana* in typical form as understood by Trelease (he characterized it in part by long, slender leaves), he attributed to "the Texas region, from New Braunfels west to beyond Devil's river and south . . ." (on his range map [t. 95, fig. 2] it does not seem to approach the New Braunfels region). The writer believes that Trelease's failure to appreciate that *Y. Torreyi* extends east into the Devil's River country and beyond to about Uvalde, constitutes the basis of his misconception of the species *Y. Treculeana*. For from about Sabinal, Uvalde Co., west and northwest to about Laguna and the Nueces River, across Kinney Co. and to Devil's River and the Pecos (both in Val Verde Co.), we are in a region where the eastern limits of *Y. Torreyi* approach the western limits of *Y. Treculeana* and where we find many plants difficult to classify as one or the other species and not far

different, in foliage characters certainly, from Trelease's concept of typical *Y. Treculeana*. In this region a marked change occurs from the soil conditions found adjacent to and extending inward from the Gulf and those which prevail in Trans-Pecos Texas; the ranges of certain capsular-fruited yuccas seem also to meet here and produce unstable forms of difficult classification; it is a meeting-ground and, although the demarcation is somewhat "ragged," a dividing line. The map figures included in two recent bulletins of the Texas Agricultural Experiment Station (Bull. no. 550, fig. 1, July, 1937; Bull. no. 551, fig. 1, August, 1937) are of value since they show, as definitely as is possible, the plant areas of the state, — among others the Edwards Plateau and Trans-Pecos regions. West of Uvalde *Y. Torreyi* is the prevailing species. The writer has found *Y. Treculeana*, readily recognized as such, only as far west in this region as Hondo, Medina Co., and as far southwest as Eagle Pass, Maverick Co. Where the ranges of the two species are contiguous unstable plants of difficult determination are many. The territory where they have been found is roughly indicated by a dotted line on the range maps of both *Y. Treculeana* and of *Y. Torreyi* although the specimens themselves are only indicated on the range map and in the citation of specimens of *Y. Torreyi*. Even so far removed from the range of *Y. Treculeana* as in southern Sutton Co., northeastern Val Verde Co., and Terrell and Pecos Cos. (in the last between Fort Stockton and Hovey), instabilities were noted on plants of *Y. Torreyi* but they were fewer and the plants on which they appeared were less numerous; the northern boundary of the eastern limits of *Y. Torreyi* lies not far north of these regions; westward and southward the species becomes more abundant and is better characterized.

In habit *Y. Treculeana* and *Y. Torreyi* at times are not very different for in certain regions each is shaggy and weatherbeaten; but on the whole the former is of a neater, more symmetrical appearance, *Y. Torreyi* except when juvenile, rather unkempt. In each the head of leaves assumes a different form, that of *Y. Treculeana* nearly hemispherical, broadest at the base, that of *Y. Torreyi* elongated, constricted below, spreading above; the leaf-blade of *Y. Treculeana* is broadened, often conspicuously, near the middle and no fibres separate along its margins; that of *Y. Torreyi* is commonly tapered from base to apex and its margins break into many loose fibres. Where the ranges of these species adjoin leaf-characters are unstable, — many blades have the narrow, tapering form found in *Y. Torreyi* but the non-filiferous margins of *Y. Treculeana* and, less frequently, the reverse is noted; floral characters too become unstable; the pistil, distinctive within the range of each species, assumes forms suggestive of both; the vase-shaped style and stigmas of *Y. Torreyi* may unite with the oblong-cylindric ovary of *Y. Treculeana*, or the parallel-sided style and abruptly spreading stigmas of *Y. Treculeana* may surmount the upward-tapering ovary of *Y. Torreyi*; again one longitudinal half of a pistil may suggest one species, the remaining half the other; a lop-sided ovary is not uncommon;¹ the base of the flower (united portion of the perianth) is unstable and at times reminiscent of both the gibbose form characteristic of *Y. Torreyi* and the saucer-shaped one common to *Y. Treculeana*. Floral abnormalities are not uncommon. Some of these confusing plants may be of hybrid origin but, since the dominating influence in each cannot be estimated, all have been cited under *Y. Torreyi*, — the large flowers under the typical plant, the small under the form; the fact that these plants extend so far west of the range of *Y. Treculeana* as at present understood, and become (as they are more remote from this range) far less numerous and with fewer instabili-

¹ A lop-sided ovary is very common in *Y. baccata*. This species does not approach the region under discussion. We have in this merely an example of what is often noted throughout the genus, — the outcropping in one species of a character or peculiarity associated with quite another plant; speculation is always aroused as to the origin of what now appears to be distinct species.

ties, makes it difficult to dispose of them as hybrids of recent origin. Outstanding among the specimens representing such plants are the following: from eastern Uvalde, northwest Zavalla and Maverick Cos. and west and northwest to the Devil's River region, Val Verde Co., *McKelvey* 2588, 2595 (small flowers), 2591, 2592, 2594, 2598 (large flowers); it was noted in the field that six of these had the long, slender leaves of *Y. Torreyi*, the non-filiferous leaf-margins of *Y. Treculeana*; nos. 2588, 2594 showed floral abnormalities; several had more or less pubescent inflorescences; from southern Sutton and northwestern Val Verde Cos., *McKelvey* 2624 (small flowers), 2622, 2623, 2626, 2627 (large flowers); nos. 2626, 2627 showed floral abnormalities; Mr. V. L. Cory of the Texas Agricultural Experiment Station, Substation 14, Sonora (not far from this very region), wrote the author (in litt. March 9, 1934): "*Yucca Treculeana* is in full bloom at the present time. I am still interested in whether there is sufficient distinction between this species and *macrocarpa* [= *Y. Torreyi*] of the Trans-Pecos area;" from western Pecos Co., from between Fort Stockton and Hovey, *McKelvey* 2633-1, 2635 (small flowers), 2633-2 (large flowers); in these the instabilities were floral, the writer noting that the foliage in all respects was that of *Y. Torreyi*. Two acaulescent, probably young, plants of this region are shown in pls. LIX, LX, LXI; many produce tall stems as in *Y. Torreyi* and in *Y. Treculeana*.

Herbaria contain specimens recognizable at once as belonging to this group of plants, intermediate between the eastern and the western species. *Charles Wright* 687 [this number represents a composite and should read 688], is found in 3 herbaria, each sheet with 2 leaves; all 6 leaves are similar, long and narrow as in *Y. Torreyi*, but, although with drying a few fibres are separating, with non-filiferous margins as in *Y. Treculeana*; the labels cite no precise locality of collection but Wright's notes (Gray Herbarium) give the date as July 19, 1849, the locality as "High prairie of the San Felipe and east to the Medina;" within a few days Wright was collecting at what he calls Devil's Canyon so we may be sure that his San Felipe creek was the one which flows into the Rio Grande east of Del Rio, Val Verde Co.; the range which he names is practically identical therefore with the one attributed by the writer to these confusing plants. *Rose and Fitch* 18001 from Devil's River is also an intermediate. The leaf of *Reverchon* 1604, from "Upper valley of the Llano . . ." (presumably in Sutton Co.), is very similar to those of the Wright collection. The leaf of *Trelease* 162, also similar, is from a plant cultivated at Spofford, — perhaps collected in the vicinity; *Griffith* 6279 is also from Spofford and presumably spontaneous. *Mearns* 1290 from Fort Clark is clearly from one of these intermediate plants. Both Spofford and Fort Clark are in Kinney Co. which adjoins Uvalde Co. on the west.

The writer has not found well-characterized *Y. Treculeana* some 250 miles, "as the crow flies," east of Sierra Blanca. Yet even at Sierra Blanca she noted among the many plants of *Y. Torreyi* a very occasional one with pistil suggesting in form the one found in *Y. Treculeana*; such, from Van Horn to and about Sierra Blanca, are *McKelvey* 2649, 2655-3 (small flowers), 2655-1, 2 (large flowers); of these nos. 2649, 2655-2 showed floral abnormalities; in all other respects the plants were unmistakably *Y. Torreyi*. Marcus E. Jones determined some of his collections from about Sierra Blanca as *Y. canaliculata* [= *Y. Treculeana*] but, as noted elsewhere, he did not have the yuccas of the region clearly in mind for, on one sheet, 2 or even 3 species sometimes appear under one name; in some of Jones' collections of *Y. Torreyi* the writer has found the pistil suggestive of *Y. Treculeana*; there is no reason to suppose that he actually found that eastern species at Sierra Blanca, nor that his determination was based upon the instability just mentioned. Sargent also considered that *Y. Treculeana* grew at Sierra Blanca but neither *Y. Torreyi* nor *Y. Faxoniana* was clear to him at the time.

Floral abnormalities (such as fasciate inflorescence branchlets, too few or too many perianth-segments or filaments, two flowers united variously into one, etc.) are not confined to the regions where *Y. Treculeana* and *Y. Torreyi* meet; they are found throughout the range of *Y. Torreyi* and are found on both typical plant and form. Abnormal flowers occur most often towards the base of the inflorescence and towards the base of the branchlets than elsewhere; they may be fairly numerous on an inflorescence or only one or two flowers may be peculiar. Of 30 specimens of large flowers collected by the writer abnormalities were present in 11; of 15 specimens of small flowers they were present in 4, or, proportionately, a little less often in the form than in the typical plant. Teratological forms are not uncommon on hybrid plants.

SECT. II. CLISTOCARPA

Yucca § 1. **Eu-Yucca** ** **Clistocarpa** Engelm. in S. Watson, Botany, King Report, 496 (1871); reprinted in Trelease & Gray, Bot. Works G. Engelm., 276 (1887).—Baker in Gard. Chron. 1871: 1516.

Yucca I. *Euyucca* B. *Clistoyucca* Engelm. in Trans. Acad. Sci. St. Louis, 3: 47 (1873); reprinted in Trelease & Gray, Bot. Works G. Engelm., 293 (1887). — Baker in Jour. Linn. Soc. Bot. 18: 220 (1880). — Ricasoli in Bull. Soc. Tosc. Ort. 6: 246 (1881).

Yucca subgen. I. *Euyucca*, sect. 2. *Clistoyucca* Engelm. ex Engler, Nat. Pflanzenfam. II. 5: 71 (1888). *Clistoyucca* (Engelm.) Trelease in Rep. Missouri Bot. Gard. 13: 41 (1902). — Molon, Yucche, 8 (1914). — Rydberg, Fl. Rocky Mts. 170 (1917); ed 2. 170 (1922). — Krause in Engler, Nat. Pflanzenfam. ed. 2, 15*: 352 (1930).

Cleistoyucca Eastwood, Occas. Papers Calif. Acad. Sci. 9: 33 (1905).

The section CLISTOCARPA is represented by one species with a dwarf variety described in 1935. Its baccate fruit is distinct from that of all other yuccas of the southwestern United States in that it is at first spongy and soon dry.¹ Parish (Gard. & For. 4: 135. 1891) has noted that its "ripe fruit manifests a tendency to the capsular structure by the replacement of what would be the dissepiments of the thick texture of the pericarp by a thin membrane which occasionally splits. . ." In its fruit *Y. brevifolia* appears to be intermediate to the fleshy-fruited and the capsular sections of *Yucca*. Its habit of growth is distinctive and old trees are more or less grotesque in appearance. Its leaves (very different from those of the fleshy-fruited yuccas) are, in their extremely fibrous character, finely striate surfaces and corneous, denticulate margins, somewhat similar to those of *Y. Whipplei* and of other capsular-fruited yuccas such as *Y. rostrata* and *Y. Thompsoniana*; in form, however, they do not resemble those of any of these species.

The paniced inflorescence is distinct in its small, compact, commonly ovoid form and produces more branchlets, bracts and flowers for its very short length than any other yucca growing in this country; it is neither showy nor handsome and its uniformly greenish flowers make it inconspicuous; nor have the individual flowers the beauty of those of most other species. While the floral structure and the various floral parts such as pistil and stamens are at times nearly duplicated in other yuccas yet, in their entirety, the flowers of the Joshua-tree are not to be mistaken; their fragrance, which has been variously described as "nauseating," "unpleasantly odorous," "oppressive," and so on, is strikingly like that of the common field-mushroom, not truly unpleasant but earthy; it has been found at times to persist after months of immersion in formalin solution; the long, nearly parallel-sided corolla-segments are unusual in form and more conspicuously thickened at apex than those of other species and those of the inner row do not, as commonly in other yuccas, expand to the base of their free portion at anthesis; the base of the flower (united portion of the perianth) is commonly gibbose, as in *Y. Torreyi* for example; the pistil in form is very like the one most characteristic of *Y. schidigera* although style and stigmas are smaller in *Y. brevifolia*; the ovary almost universally bears near the base the enlarged and conspicuous impress of the anthers; the filaments are attached (as in the series Treculeanae) below or just at the base of the ovary and each is free from those adjacent at this point; they are stiff, noticeably resilient, with a nearly globose clavate tip; the bracts of the inflorescence (those which are half bract-like, half leaf-like) resemble somewhat those found at the base

¹ *Y. gloriosa* of the eastern seaboard has been said to produce a fruit with very similar exocarp; it has not been seen by the writer in fresh condition.

of the branchlets of *Y. Whipplei*, but this resemblance is confined to the bracts just specified; the fruit cluster is distinct, as a rule ovoid and closely packed with spreading fruits, and the individuals comprising it in their composition and form (symmetrical and nearly uniform in size) are quite unlike those of any yucca of the southwest.

The not uncommon variability and the abnormalities found in the flowers of most other yuccas are rare in *Y. brevifolia*; the species appears to be stable and, for this reason, may perhaps be considered to be the oldest of the genus; its appearance certainly suggests antiquity.

YUCCA BREVIFOLIA

Yucca brevifolia Engelm. in S. Watson, Botany, King Report, 496 (1871).

Yucca Draconis var. *arborescens* Torrey in Botany, Whipple Report, 147 (1856). — Engelm. in S. Watson, Botany, King Report, 496 (1871), as a synonym of *Y. brevifolia* Engelm.

Yucca arborescens (Torrey) Trelease in Rep. Missouri Bot. Gard. **3**: 163, tt. 5, 49 (1892), in synonymy as a possible substitute name; **9**: 145 (1898). — Merriam in N. Amer. Fauna, no. 7, pt. II. 353, frontispiece, t. XIII., map 5 (May 31, 1893). — Coville in Contrib. U. S. Nat. Herb. **4**: 201, frontispiece (Nov. 29, 1893).

Clistoyucca arborescens (Torrey) Trelease in Rep. Missouri Bot. Gard. **13**: 41, tt. 6, 7, 85, fig. 10, 87, fig. 1, 88, fig. 2 (range map) (1902).

Cleistoyucca arborescens (Torr.) Eastwood in Occas. Papers Calif. Acad. Sci. **9**: 33 (1905).

Clistoyucca brevifolia (Engelm.) Rydberg, Fl. Rocky Mts., 170 (1917). — MacBride in Contrib. Gray Herb. n. s. **53**: 6 (1918).

SUPPLEMENTARY REFERENCES. Sub *Y. brevifolia*: Engelm. in Trans. Acad. Sci. St. Louis, **3**: 47, 213, 371 (1873). — S. Watson in Proc. Amer. Acad. **14**: 252 (1879). — Baker in Jour. Linn. Soc. Botany, **18**: 221 (1880). — Trelease in Rep. Missouri Bot. Gard. **4**: 193, tt. 6, 7, 8, 9, 21 (1893). — Schimper, Pflanzengeographie, 669, fig. 369 (1898). — Neubert's Garten-Mag. **52**: 97, t. (p. 109) (1899). — Jepson, Silva Calif. 170, t. 54 (1910); Flora Calif. **1**: 314 (1922). — Sargent, Man. Trees N. Amer. ed. 2, 116, fig. 112 (1922). Sub *Y. arborescens*: Sargent, Silva N. Amer. **10**: 19, t. 502 (1896); Man. Trees N. Amer. 122, fig. 107 (1905). — Sudworth, Forest Trees Pacif. Slope, 201, figs. 79, 80 (1908). — Karsten and Schenck, Vegetationsbild. **14**: tt. 37, 38a (1922).

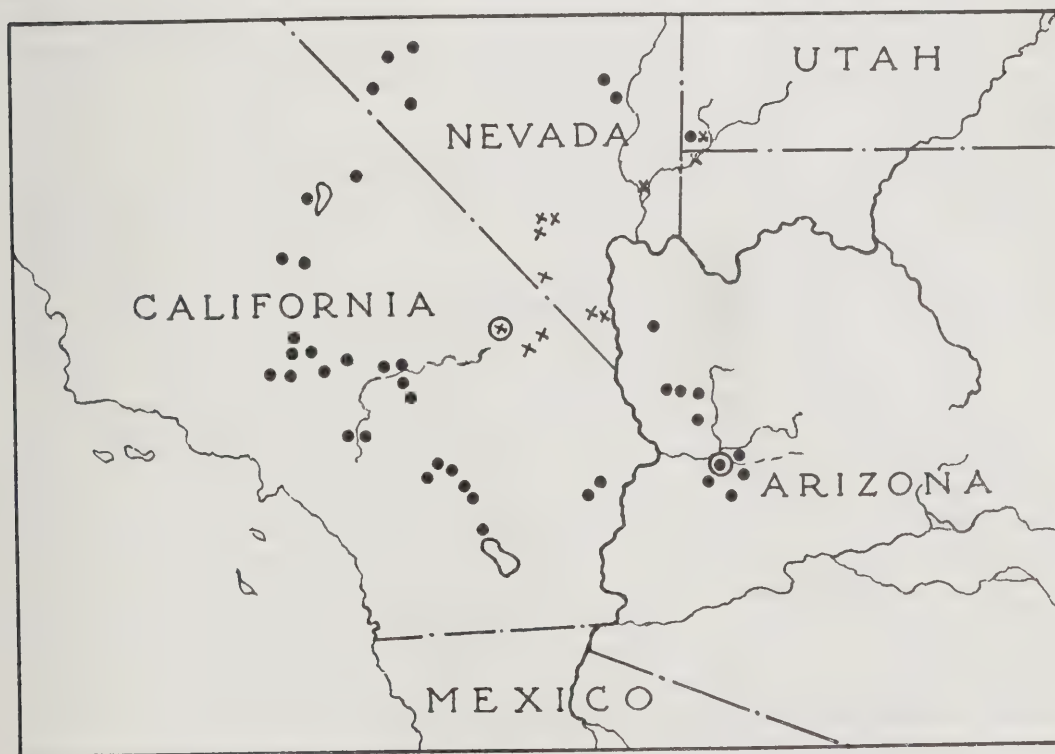
Plant often 6–9 m. in height (certain recorded specimens twice that size), commonly with one stem, occasionally with several or even many, branching at 0.6–1.3 or 2.5–3 m. above ground; stem stout, abruptly enlarged immediately at the ground into a broad circular base, denuded of leaves to or above the first forking; branches fork every 0.6–1 m. or more, central or inner ones of crown erect-ascending, outer ones horizontal or drooping, denuded of leaves near base, just above covered with shaggy thatch of dead, reflexed-spreading dead leaves, at ends with encircling green leaves, these spreading or erect-ascending; crown at first dense, eventually open, broad, flat- or round-topped. Bark reddish brown or gray, rough, broken by narrow, deep, vertical and horizontal fissures into conspicuous plates 7.5–15 cm. in length, 2.5–5 cm. in depth. Clusters of leaves encircling ends of branches 1–1.5 m. in length (juvenile plants), 0.3–1 m. (mature plants), 0.3–0.5 m. in diameter, densely crowded, for most part shaggy in appearance. Base of mature leaf tenaciously attached, broader than long, its median length 2.5–4 cm., its breadth at insertion 4–5 cm., at union with blade 1.2–2.8 cm.; epidermis smooth, glossy, white or cream, often marked at base with thread-like crimson line. Blade of mature leaf 19–37 cm. in length, slightly constricted at union with base, thence tapered to apex, straight, rarely falcate, rigid especially near base (young leaves more flexible), its lower $\frac{2}{3}$ plano-convex (the outer, convex surface often sharply keeled), the upper $\frac{1}{3}$ concavo-convex (the keel often sharply toothed), its inner surface for entire length marked by a slender median rib, smooth to slightly scabrous on both surfaces, somewhat glaucous, a uniform pale blue- or sage-green; leaf-margins thin, with narrow, horny, lemon-yellow border edged

with short, sharp, straw-colored teeth; apex acuminate, dark red-brown; spine 0.7–1.2 cm. in length, stiff to flexible, acicular, dark reddish brown at base, at tip straw-colored. Inflorescence 0.3–0.5 m. in length overall (scape stout, noticeably tapered, 10–15 cm. in length, 4.5–5 cm. in diameter at base); inflorescence proper paniced, straight or decurved near tip, ovoid to slightly obovoid, .30–.38 m. in breadth, rounded or acute at apex (racemose tip exceeding tips of branchlets by 5–7.5 cm. at most), exerted, at anthesis densely crowded, very heavy, fleshy, brittle, commonly glabrous, pale or deep sage-green, rarely tinged with lilac; at base and near top flowers produced singly or in pairs on central axis or on abortive branchlets, between on short branchlets; branchlets very numerous (basal and uppermost about 2.5 cm. in length, central 5–7.5 cm.), basal ones spreading, upper erect-ascending; pedicels 0.7–1.0 – rarely 2.5 cm. in length, terete below, near union with flower flattened, slightly enlarged, stout, stiff, erect or spreading; bracts on scape many, 25–30 in number, those just above basal leaf-like ones 25–30 cm. in length, with elongated base and shortened leaf-like tip; uppermost bracts on scape with bract-like base 10–12 cm. in length, above abruptly contracted into a leafy tip 4–5 cm. in length; bracts at base of lower branchlets similar to those on upper scape; those at base of central and uppermost branchlets broad-triangular to broad-ovate, thick, spongy to leathery (chamois-like) throughout, with rubbery, spinescent tip, becoming smaller upward, at first cream-colored tinged with rose and lilac, at anthesis already papery, dry, brittle, white or gray; bracts at base of pedicels about 2.5 cm. in length, 7 mm. in breadth at insertion, narrow-triangular to lanceolate, at first like a thin tissue-paper, soon dry, brittle; flowers 4–7 cm. in length, with base (united portion of perianth) conspicuously gibbose, rarely cup-shaped or 3-sided, with long, narrow, nearly parallel-sided, thickish, fleshy, brittle, waxy perianth-segments commonly much thickened, rarely a little broadened, pubescent and hood-shaped at apex, dull greenish yellow to sage-green, rarely cream; segments of inner row slightly longer, rarely shorter, narrower, thicker, stiffer than those of outer row, their lower portion bulging, their upper portion spreading or reflexing at anthesis; segments of outer row flaccid, scarcely expanding at anthesis; filaments short, about 1.2 cm. in length, attached below or just at the base of ovary, and at attachment rarely touching those adjacent, their major lower portion stiff, hard, resilient, tightly appressed to ovary or at middle bulging from it (snapping back if displaced), plano-convex, short-fleshy-pubescent to papillose, their clavate tip $\frac{1}{8}$ of entire filament in length, nearly globose, at anthesis erect-ascending, papillose; anthers sagittate, 3.2 mm. in length, the basal lobes $\frac{1}{4}$ of length of anther; pistil 2.5–3.2 cm. in length; ovary ovoid, 3–4 times longer than broad (about 1 cm. in diameter at base, 3.2 mm. at union with style), uneven to rough surfaced, with 3 deep, sharply cleft primary fissures, the 3 intervening lobes round to flat-backed, at times marked with enlarged impressions of anthers; style not exceeding 1.6 mm. in length, as broad as long, with parallel sides, terminating at base in 3 ill-defined, exceedingly short tips, at apex in 3 erect, short-emarginate stigmas 1 mm. in length; fruit 6.5–10 cm. in length, 4.5–6.5 cm. in diameter, commonly ovoid, less often obovoid or ellipsoidal, plump throughout, with acute to rounded apex tipped with persistent style and stigmas, with primary (and rarely secondary) fissures indicated by broad (or by narrower and deep) triangular indentations or, occasionally only, sharply cleft, the intervening lobes round to flat-backed and near middle often marked with enlarged impressions of anthers, first green, eventually reddish brown or nearly black; exocarp smooth to slightly granular; perianth-segments and filaments long-persistent, at first erect, eventually reflexed.

Range. In California mainly, if not entirely, confined to the Mohave Desert whence it extends east into adjacent Arizona and east and northeast across southern Nevada and into extreme southwestern Utah.

CALIFORNIA. San Bernardino Co.: Mohave slopes, San Bernardino, May 14, 1882, C. R. Orcutt 263 (M). — Southern edge of Mohave Desert, between Keyes Ranch and Quail Springs, dry plains, alt. 900 m., May 7, 1922, P. A. Munz and I. M. Johnston 5289 (UC) (PO). — Cactus Flat in

Cushenbury Canyon, May 12, 1926, *M. E. Jones* (PO). — Between Yucca and Morongo Valleys, April 28, 1932, *McKelvey* 2711 (AA). — In desert sand, Hesperia, April 21, 1917, *M. F. Spencer* 554 (G) (PO). — Hesperia, March 23, 1895, *J. H. Jennings* (5 sheets and fruit; AA). — Hesperia, April 10, 1892, *W. Trelease* (M). — West of Hesperia, open desert, 1050 m., April 28, 1921, *P. A. Munz* 4556 (PO). — California, 1853-4, *J. M. Bigelow* (W 40566; **type** of *Y. Draconis* var. *arborescens* Torr.) (P). — California Desert, June 12, 1876, *Palmer* (M); June, 1876, *E. Palmer* (M). — Mohave Desert, Jan., 1881, *C. C. Parry* (3 sheets; M). — California Desert, 1882, "from *G. Engelmann*" (G). — Mohave Desert, May, 1882, *S. B. and W. F. Parish* 419 (S) (W) (AA). — Mohave Desert, Aug., 1882, *Parish Bros.* (M 135650) (AA). — Mohave Desert, May 13, 1882, *C. G. Pringle* (G) (W 40571); May 13, July 4, 1882, *C. G. Pringle* (M 135652) (W 40572); May 13, July 4, 1882, *C. G. Pringle* 466 (W); Mohave Desert, July 4, 1882, with drawing (Henchman del.) attached, *C. G. Pringle* (W). — Mohave Desert, March 16, 1932, *Mrs. Rodda* (CA); April 1, 1932, *Mrs. A. H. Rodda* (AA). — Mohave Val[ley] and eastward, forms straggling forests, textile, July, 1876, *Lemmon Herbarium* (UC). Kern Co.: "Mohave Station, S. San Bernardino Co.," 1879, *W. E. Wright* (G). — California Desert, Mohave, Sept., 1882, *Parish Bros.* (M). — Near Mohave, June 1, 1895, *W. R. Dudley* 519 (S). — Mohave, May 13, 1913, *A. Eastwood*, 3230 (M) (G). — Between Willow Springs and Tehachapi, alt. 1200 m., June 25, 1908, *Leroy Abrams* and *E. A. McGregor* 430 (G) (S) (AA). — West side of Walker Pass, alt. 1100 m., *Leroy Abrams* 11931 (S) (UC) (PO). — Between Weldon and Onyx, alt. 800 m., June 28, 1932, *H. M. Wheeler* (UC).¹



MAP 8. Ranges of *YUCCA BREVIFOLIA* (●) and var. *JAEGERIANA* (×).

¹ Of the specimens cited above the following have extremely short leaves: *Bigelow* (W 40566), *Parish Bros.* (M 135650) (AA), *Pringle* (M 135652) (W 40571, 40572), *Spencer* 554 (G) (PO), *Eastwood* 3230 (M) (G). Unfortunately the first three cite no precise locality; whether they came from that part of the Mohave Desert where the variety is prevalent we do not know; Pringle and Parish did most of their collecting about Mohave, Kern Co., and Victorville, San Bernardino Co., — not, therefore, in the range of the variety. It has been thought best to cite these specimens under the typical plant although the leaves are smaller than those characteristic of it. Both Spencer and Eastwood specimens come from outside the range of the variety; their narrow leaf-bases indicate immaturity and they probably came from the heart of a leaf-cluster and would not be truly representative of either typical plant or variety.

ARIZONA. Yuma Co.: Ehrenburg [?], 1874, *A. E. Janvier* (G). — Date Creek, [1869], with Parry note attached, *Palmer* (M 135643, 135646; type of *Y. brevifolia* Engelm.). Yavapai Co.: Date Creek, Yavapai Co. and Mohave Desert, Arizona, June 5, 1906, *Kunze* (M). Mohave Co.: Valley of Big Sandy River, north of Wickieup, March 8, 1930, *McKelvey* 1511 (photos. 73-3, 5, 8) (AA). — Yucca, Aug., 1906, *W. Trelease* (M). — Near Yucca, common in open desert, June 15, 1921, *R. S. Ferris* and *C. D. Duncan* 2226 (M) (S). — Just east of Yucca, alt. ca. 550 m., April 1, 1930, *McKelvey* 1660 (photos. 84-1, 4, 7) (AA); May 13, 1931, *McKelvey* 2230A (AA); March 14, 1932, *McKelvey* 2533 (photo. 116-4), 2534 (photo. 117-1), 2538, 2539 (photo. 116-2), 2540 (photo. 116-10), 2541 (photo. 116-6), 2542 (photo. 116-8) (AA); March 15, 1932, *McKelvey* 2543 (photo. 117-1), 2544 (AA). — Four miles northeast of Littlefield, May 4, 1934, *McKelvey* 4160 (AA). Without precise locality: Arizona, 1867, *Parry* (M). — Arizona, 1869, *Bigelow* [?] (M). — Arizona, 1869, *Palmer* (M 135642) (M 135641; as to seed labelled 1871.)

NEVADA. Esmeralda Co.: Goldfield, alt. 2000 m., June 4, 1912, *A. A. Heller* 10411a (S) (G) (M). Nye Co.: Near Ralston, March 17-24, 1924, *R. S. Ferris*, *F. M. Scott* and *R. Bacigalupi* 4051 (S).

Lieutenant J. C. Frémont seems to have been the first to write of the Joshua-tree; in his *Report*, under date of April 13, 1844, he tells of being "struck by the sudden appearance of yucca trees which gave a strange and southern character to the country. . . Associated with the idea of barren sands, their stiff and ungraceful form makes them to the traveller the most repulsive tree in the vegetable kingdom. . ." On April 15 and 17 he again refers to this yucca and calls the sage-brush "the ominous *Artemesia tridentata*." Considering the conditions of travel in 1844 Frémont could hardly have been expected to enjoy the picturesque aspect of the Joshua-tree.

In 1853-1854 the War Department sent an expedition to explore and make surveys for a railroad route from the Mississippi River to the Pacific Ocean, with Lieutenant A. W. Whipple in charge of topographical engineers. Dr. J. M. Bigelow, surgeon and botanist of the expedition, is the next to mention this yucca. Under section (IX.) (Whipple Report, 4: no. 1, 14, 15. 1856) which describes the Valley of the Colorado he wrote: "In addition to the trees already mentioned, we noticed vast quantities of the tree Yucca, called by the Mexicans *Palma*. It was seen before at Bill Williams' fork [Arizona], but it is found here from twenty-five to thirty-five feet in height, and eighteen inches or two feet in diameter, with a bark on the lower part of the trunk very much resembling that of the white oak. Although not good for fuel, we were sometimes under the necessity of resorting to it for camping purposes." Under section (X.) which describes the Mohave Valley of California, he wrote: "Immediately on passing the crest of the Cajon [Cajon Pass], the vegetation changes like magic. . . A species of Yucca, different from the five or six other Texan and New Mexican species that we had seen before, was collected at this place. . ." ¹

Torrey, who determined the botanical collections of the Whipple Expedition, described as *Yucca Draconis* . . . var. *arborescens*, a Bigelow specimen from "Sandy and gravelly plains west of the Colorado, California," he wrote: "Dr. Bigelow states that this species attains the height of 30 feet, with a diameter of 18 or 24 inches. He found 'whole forests' of this tree on the Mohave creek. The leaves are flat, about 3½ inches long, and from ⅓-½ an inch wide, thick, convex below, flat or concave above, pointed with a strong spike, the broad flat base about half as long as the upper rigid and narrower portion. For want of more complete specimens we cannot be certain of the species." There is a Bigelow

¹ Bigelow's reference to the size of these yuccas, the appearance of their bark and the fact that they grew at Bill Williams Creek identifies the species; it seems a little strange that, finding them for the second time in California, he does not mention that they had been met before. There is a specimen in the U. S. National Herbarium (W 35905) bearing a Whipple Expedition label which notes Bigelow as collector; it is labelled Cajon Pass but bears no date; it was determined as "*Yucca aloifolia*?" and this was changed, probably by Engelm., to *Y. Whipplei* Torr. The two leaves of this specimen, to the writer, more nearly resemble those of *Y. brevifolia* than those of *Y. Whipplei* but they are in such poor condition that any determination is open to question.

specimen (W 40566), bearing Torrey's determination, which consists of one very short leaf and one bract; this, since its lower half is bract-like, its upper half leaf-like, must have come from the scape; Torrey's "broad flat base about half as long as the upper rigid and narrower portion" describes this bract, not the leaf of the specimen; the locality of collection was "California." A similar bract is in the herbarium of the Philadelphia Academy.

On an entertaining profile map showing the camps of the expedition the various trees along the route are indicated in miniature, colored; the symbol for the yucca is explained as "Yucca sp. un. Tree Yucca;" the abbreviation "un." would seem to stand for *unum* and indicate that only one species is shown. The profile map shows it in Arizona, intermittently, from not far west of Big Horn Spring to the mouth of the Big Sandy River and between the Big Sandy and the mouth of the Williams River (also called Bill Williams River); in California it is shown on both sides of the divide between the valleys of the Colorado and Mohave Rivers and in the valley of the latter. The Bigelow specimen, labelled only "California," may have been collected along the route of the expedition anywhere between the Colorado River and Cajon Pass; while it is here chosen as type of Torrey's *Y. Draconis* var. *arborescens* the type locality includes a large territory. The leaf of this specimen is small and suggests in size those of the dwarf variety of *Y. brevifolia*; this variety is not known to grow south and east of the Colorado in Arizona. The route taken by the Whipple expedition in California lies south of its known range in that state. Leaves of such a small size are not infrequently found on the typical plant although not truly characteristic of it; many leaves in herbaria because of their small size are also suggestive of the variety but come from regions outside of its known range; perhaps here, as in some other yucca collections, the small leaves are indicative of the collector's propensity to gather convenient rather than representative material.

Engelmann was the next to write of the Joshua-tree. In 1871 he published its description, under the name *Y. brevifolia*, in a supplement to the *Botany* (attributed to Sereno Watson and others) of the U. S. Geological Exploration of the 40th Parallel; Clarence King was in charge of this expedition. Engelmann gave the plant's range as "Deserts of S. Utah, through Arizona, to S. E. California. . ." he cited no specimens but gave *Y. Draconis* var. *arborescens* Torr. as a synonym.

The material available to Engelmann in 1871 was meagre; no flowers or fruit are represented now although a few seeds and bits of fruit-pericarp are included with material from Arizona. From California there was only the Bigelow specimen just discussed which represents Torrey's *Y. Draconis* var. *arborescens*. From Utah there was foliage — it is found in three herbaria (W 40569) (M 135644) (G) — collected by J. E. Johnson in 1869; an attached note (M 135644), evidently written by Parry, refers to "*a living plant! 1 foot high*" which had been sent from St. George to Washington; it seems probable that the leaves, all very similar, on these three sheets came from this plant, and were distributed from Washington to Engelmann and the Gray Herbarium; it also seems probable that "St. George, Utah" was regional, or represented the shipping point as the label indicates, for on one sheet (W 40569) that locality is scratched through and "Southwestern Deserts" substituted; the Joshua-tree does not seem to grow in the vicinity of that city now, and, although Merriam cites the plant from the Upper Santa Clara Valley, his Map 5 does not show it except west and south of the Beaverdam Mts.; here the writer also found it; all the leaves collected by Johnson are small, suggestive of those found on the dwarf variety of the Joshua-tree which predominates in southern Utah although herbarium material proves that the typical plant occurs farther north in that state. From Arizona there was a specimen (M 135639) bearing Parry's name, dated 1867, labelled only "Arizona;" it consists of fragments of leaves, bark and wood, and sections made from leaf and bark.

There was also material, represented on four sheets in the Engelmann Herbarium (M 135641, 135642, 135643, 135646) which seems — with the exception of miscellaneous fragments of fruit-pericarp and some seed which were evidently included at a later date — to represent one collection made by Edward Palmer in 1869. Two of these sheets (M 135643, 135646) bear very similar material, — each the half of a leafy shoot which was split longitudinally; the leaves, while not as long as are sometimes found on the typical plant (not much longer indeed than those of the Johnson collection) might well have represented small ones of that form; moreover only the typical plant is known from this part of Arizona. To one of these sheets (M 135643) is attached a Parry note which reads: "Here is a branch of *Yucca brevifolia* the tree Yucca from Date Creek, the same as the desert one of which you got a trunk from Pacific R R office — ! Still better Dr. P[almer] says that the fruit of *Yucca intermedia* fide Engl. is this plant!!! So now you have full material except the flower which we will get from Utah. Call again at office of Kansas Pacific and ask to see a photograph No 12 of their series which shows a full grown specimen. I have a pencil sketch also to send when I can lay my hands on it. . . . You must divide this branch if you want to keep any of it." At the end, in another handwriting, is added "Dr. Parry script April, 1870."¹

Since the best material available to Engelmann in 1871, or when he described *Y. brevifolia*, seems to be represented on these sheets (M 135643, 135646) the writer has chosen them as type of that species. From California Engelmann had only (see footnote, p. 122 above) the Bigelow specimen from the Mohave Desert (type locality, as has been stated, of *Y. Draconis* var. *arborescens* Torr.). The Johnson material is from a somewhat vague locality in Utah and, because of its uniformly small leaves is believed to represent the variety which is the predominating form in the southern part of that state; since the collection is inferior in quality and in labelling to the Palmer material we are spared the embarrassment of being obliged to consider it the typical plant and treating the well-known Joshua-tree as a variety of it.

The type locality is Date Creek; there is a town of this name in Yavapai Co. but the reference is probably to the stream, so called, which rises in Yavapai Co. and flows west emptying into the Santa Maria in Yuma Co.; we cannot be positive in which county the type locality falls; the writer has placed it in Yuma Co. The Whipple expedition did not go so far east as Yavapai Co. but was close for the plant was mentioned at Bill Williams Fork and the Santa Maria flows into the Williams River. The writer collected the Joshua-tree in the valley of the Big Sandy River which empties into the Santa Maria and photographed it growing with the giant-cactus; Bigelow wrote (in his section VIII. which describes the Santa Maria valley): "By far the most interesting cactus of this region, and probably of the whole world, is the *Cereus giganteus*. We saw it for the first time, in this valley, on the 4th of February, growing about forty-five feet high. . ." It is pleasant to imagine that Bigelow may have admired the same trees. It was perhaps because of information derived from the Whipple Expedition reports that Palmer later went into the region; he is known to have been at Fort Whipple near Prescott before 1870 and "made

¹ It seems probable that a nice little pencil sketch attached to a Pringle specimen (W 40573) may be the one of which Parry wrote for it is labelled "To be returned to C. C. Parry. . ." It shows Joshua-trees at various stages of development and gives some useful data; it is labelled "*Yucca brevifolia* Desert east of Tejon Pass Feb 3d 1868 (Henchman [?] (del) . . ." It also seems probable that a photograph found in two herbaria (M 140140) (G; Johnson, St. George, Utah, 1869) is the "No 12" mentioned by Parry for on the back of the first mentioned is written: "Dr. Engelmann with regards of C. C. Parry, June 23d/70, taken 1867, *Yucca brevifolia* Engel. Desert east of Sierra Nevada 35° Lat." This picture was reproduced at least twice (Rep. Missouri Bot. Gard. 3: t. 5. 1892; Amer. Agriculturist, 50: no. 12, fig. 1, 688. 1891); Trelease's citation of plates in the first of these references notes the photograph as taken in 1870 but Parry's note indicates that it was presented to Engelmann in that year but taken in 1867. It represents the typical form.

various excursions to neighboring localities. . .” of which Date Creek may well have been one. (Pop. Sci. Monthly, **38**: no. 4, April, 1911).

In 1873 Engelmann stated that Parry had just sent a flower specimen (the first), the text would indicate from southern Utah. It is curious that the only Parry specimen found from that state, his no. 257 (UC; ex herb. Engelmann), is dated 1874. This specimen has been referred to the variety and as from Nevada since the locality of collection (“Desert near Muddy and Virgen Rivers”) seems to lie in Clark Co., Nevada. Parry’s account (Amer. Naturalist, **9**: 141. 1875) is interesting: “Near the close of the day in ascending the last sloping ridge, leading down to the opposite side of the wide desert plain through which the Muddy courses to unite with the Virgen, we first recognized one of the principal objects of our journey in the singular forms of that remarkable desert production, *Yucca brevifolia* Engelmann. This is universally known among the Mormon settlers under the name ‘The Joshua.’ The mail rider over these desert tracts had furnished us weekly reports of its progress in flowering, so that we were constantly on the lookout for a first view of what had never yet been examined by a scientific botanist. At first a few scattering clumps of the peculiar stiff spiny leaves that characterize this genus of plants attracted attention, then some gaunt forms raised on withered trunks revealed the identical species. On hastening forward to a more vigorous growth, where the masses of compact flowers were visible at a distance crowning the top of the upper branches or main axis, we soon had one of the flowering stems ruthlessly torn down for a closer inspection. The first feeling was one of disappointment; the flowers, crowded in a close pyramidal head, failed to exhibit the ordinary graceful forms pertaining to the Liliaceae. The perianth was of a dull greenish-white color, its divisions long-linear, thickened and confusedly massed together, while the odor given out was decidedly foetid, seeming to present special attractions only to various beetles and insect larvae. . . Only a few of the flowering stems perfect fruit, and occasionally (as during the present season) all prove abortive, possibly owing to the absence of some insect agency for effecting fertilization. In the desert districts lower down, where this species especially flourishes, the flowering heads are said to weigh frequently over fifty pounds. . .”

The history of the plant’s name is as follows: Torrey considered that the Bigelow specimen represented a tree form of *Yucca Draconis* L. and called it *Y. Draconis* var. *arborescens*. (Trelease in 1902 cited *Y. Draconis* L. as a synonym of *Y. aloifolia* *Draconis* (L.) Engelm.; the leaf-margins of both *Y. aloifolia* and *Y. brevifolia* are denticulate which probably explains Torrey’s misdetermination.) Engelmann in 1871 gave the plant the new name *Y. brevifolia*, reducing Torrey’s variety to synonymy. In 1892 Trelease wrote: “If the varietal name were adopted, this would be *Y. arborescens* (Torr.);” in 1898 he made the change, writing: “*Y. brevifolia*, Trelease . . . becomes, for reasons of priority, *Y. arborescens*, Trelease. . .” Engelmann’s name *Y. brevifolia* (1871) was discarded by Trelease in 1902 when he took up Schott’s manuscript name *Y. brevifolia* (1855) for the species now called *Y. arizonica*; he stated: “The later *Y. brevifolia*, Engelmann (1871). . . is now proposed as the type of the genus *Clistoyucca* under its first published (varietal) name *arborescens*.” (The transfer of this *Yucca* to the genus *Clistoyucca*, also spelled *Cleistoyucca*, was made by Trelease on the basis of certain flower and fruit characters and is discussed in the introduction; the word is from the Greek κλειστός, closed, and *Yucca*, referring to the indehiscent fruit. Various authors have followed Trelease’s classification.) Rydberg in 1907 first recognized that the specific rather than the varietal name should be considered in establishing priority and that the epithet *brevifolia* being the oldest in its category should be accepted. MacBride, failing to note that Rydberg had made this necessary transfer, argued for it a year later.

The writer has studied *Y. brevifolia* in four of the southwestern states. In Arizona only the typical plant has been seen. It was plentiful east of Yucca, Mohave Co., which lies south of Kingman in the Sacramento Valley, to the east of the Black and to the west of the Hualpai Mts. East across the last it was found in the valley of the Big Sandy north of Wickieup, in full flower on March 8, 1930; it extends even further east in this region for Kearney and Harrison 7633 came from the east slope of the Acquarius Mts., near the border of Mohave and Yavapai Cos. (Jour. Wash. Acad. **22**: no. 8, 225. 1932); these collectors state that Musgrave and Hastings found it some 30 miles south of this, or probably at the southeastern limit of its range. Concerning the precise range of the Joshua-tree in this region Mr. M. E. Musgrave wrote (in litt. Dec. 13, 1934): "The largest forest of Joshua trees is located west of Congress Junction. It starts about 12 miles west of Congress Junction and extends west for about 25 miles. It extends north nearly to Date Creek and south within a few miles of Aguila and the Santa Fe cut-off railroad. There are some of the largest and best trees in that forest that I know of any place in the west. I would hesitate to make that location on the enclosed map; however, I believe you could take the description I have given and work it out on a larger map very easily. For several years a group of people interested in natural history met at the Joshua forest west of Congress Junction during the blooming season each year, and it was proposed to have at least a part of this area made into a state or national park or forest so that the trees would have protection, since practically all of this land at the present time is public domain." The area outlined by Mr. Musgrave appears to include the southwestern part of Yavapai Co. (lying south and west of the town of Date Creek), the extreme northwestern corner of Maricopa Co. (centering about Aguila), and a small portion of northeastern Yuma Co. (lying just south of the Santa Maria). One of the Johnson specimens (G) from Utah, to which reference has been made, bears a label (collection of William M. Canby) indicating that 2 bits of fruit and seeds were collected by A. E. Janvier at Ehrenburg, Arizona, in 1874. The specimen is very poor but of interest because collected considerably southwest of the Date Creek region and of the one outlined by Mr. Musgrave. Ehrenburg lies in about the same latitude as the Cottonwood Mts., the southernmost record of the plant in California; the seed albumen of the Janvier specimen is not ruminated as seed of *Y. brevifolia* (and of the capsular species) is said to be. The Joshua-tree about Yucca has been mentioned; the stand is large and the plants are of good size; in some of the silty arroyos of the foothills to the east and southeast, where protected from wind and possibly growing in a better, moister soil, plants were sometimes very large (see pl. LXX); one was photographed which had produced many stems and formed a great clump, which is unusual (see pl. LXXI). In the region of Yucca the plants flower early; at Williams, some 150 miles east, the country was ice- and snow-bound on March 13, 1932; on March 14, *Y. brevifolia* was in perfect bloom about Yucca where the altitude is about 550 m. and the region hot; here, as elsewhere, it was noted that all plants of the Joshua-tree seemed to come into bloom simultaneously, with fewer laggards than in other species. In the northwestern part of Arizona *Y. brevifolia* extends into the Detrital Valley north of Kingman. Merriam wrote: "Mr. Vernon Bailey informs me that *Yucca arborescens* forms an extensive forest on the low divide between Detrital and Sacramento Valleys, reaching northward along the sides of Detrital Valley for about 24 kilometers (15 miles) north of Mountain Spring." This spring does not appear on recent maps but Dr. Bailey wrote (in litt. Dec. 19, 1934): "Mountain Spring in 1889 was on the freight road from the ferry across the Colorado River at mouth of Virgin River to Kingman. It was 47 miles south of the Colorado, nine miles north of Dolans Spring and about 35 miles north of Mineral. It was the first water south of the Colorado and was only a hole in the ground from which a man

who had fenced it in sold water at 50 cents for a team. It seems to have disappeared from the maps." Having found *Y. brevifolia* in extreme northwestern Mohave Co., (about Littlefield in the valley of the Virgin River) the writer was anxious to learn whether it extended continuously from southern Mohave Co. and crossed the Colorado to reach this point, or came there from the southwest, keeping west and north of the Colorado, for about Littlefield, where Arizona, Utah and Nevada adjoin, are found the typical plant (the only form in Arizona south and east of the Colorado), the variety (the prevailing form in eastern California and southern Nevada), and intermediates. Mr. Musgrave in the letter already quoted wrote that he "found them growing . . . in Detrital Valley near Chloride. I do not know the extent of that area, but I am of the opinion that they do not extend down to the river; only to the breaks. . ." No record, therefore, places the species (south of the Colorado in Arizona) any great distance north of Chloride, from which town Mountain Spring is not far northwest.

In California the typical plant is found in Riverside Co., Jepson citing it from the Cottonwood Mts.; this seems to be the southernmost station in the state; Mr. E. C. Jaeger's handbook (California Deserts, 190. 1933) states that "its southernmost station in California is, I believe, in the Iron Mountains of eastern Riverside County, where a few trees grow along the Aqueduct road between Boulder Well and Rice." The Cottonwood Mts. lie west and slightly further south than the Iron Mts.; Mr. Jaeger's station is the most southern in the extreme eastern part of California. Its prevalence in the western part of the recently established Joshua Tree National Monument, or to the north of the Cottonwood Mts., is later mentioned. It is strange that, in the many herbaria examined, not a specimen from this county has been found; and the writer is ashamed to state that although she photographed the plant in this county she made no specimens! It is plentiful in San Bernardino Co. The writer has studied it more than once in both Morongo and Yucca Valleys through which passes the road from near Whitewater to Twenty-nine Palms; the elevation of the first named valley is about 750 m., of the second a little over 900 m.; the flats were covered with specimens of every size and they extended a short way up the ravines into the foothills; on April 28, 1932, they were in fine fruit; again, in the winter of 1935-1936, much remained in good condition from the previous spring; the species was reproducing itself plentifully; many young, still unbranched plants had set their first cluster of fruit. These valleys are in San Bernardino Co., close to the Riverside Co. line and, it is to be hoped, are included within the Joshua Tree National Monument (Amer. Forests, 42: no. 11, 448. 1936) rather than to the west of it (Westways, 29; no. 2, pt. 1, map, p. 22. 1937). The plant is plentiful from Keys (or Keyes) Ranch to Inspiration Point, long called Keys Point, (see pl. LXXIII), where, at an altitude of 1700 m., from the rim of the Little San Bernardino Mts., one gets a superb view up and down the north arm of the Colorado Desert; this point lies in Riverside Co., as does most of the Monument.

Yucca brevifolia, has been noted by various writers as occurring in the Colorado Desert, in the region of Twenty-nine Palms, and this should be discussed. The Chuckwalla Mts., southeast of the Cottonwoods, and other adjacent ranges are said to separate the Mohave Desert from the Colorado Desert lying south (and extending east and southeast towards Arizona), and west and southwest (about the Salton Sea basin); the north arm of the Colorado Desert, which includes Coachella Valley, lies west of the Cottonwoods and the Little San Bernardinos, and east of the Santa Rosa and San Jacinto Mts.; this northern arm, at about the Riverside-San Bernardino Cos. line, turns northeast around the north end of the Little San Bernardinos and at about this point Morongo Valley is situated; this valley seems to lie to the west end of a gap leading into the Mohave Desert

(the gap terminates to the east near Warrens Well) and Twenty-nine Palms lies about 25 miles beyond or well within the Mohave Desert. The writer has found *Y. brevifolia* beginning at the eastern end of Morongo Valley, crossing the pass which mounts into Yucca Valley, and continuing east through that Valley towards Twenty-nine Palms; this would place it *between* the Colorado and Mohave Deserts if the gap described may be considered as the connecting link between them; the writer has not yet found *Y. brevifolia* in what she understands as the Colorado Desert. The limits of these two deserts, in this particular region, are shown differently and somewhat unsatisfactorily on most maps and are not clearly defined in the literature. Dr. Jepson (in litt., Nov. 18, 1936) mentions *Y. brevifolia* from "Colorado Desert, Twenty-nine Palms." And S. B. Parish, in a lecture delivered in 1920 (see Ecology, **11**: 481-499. 1930) stated: "The Chuckwalla, which forms the division between the Mohave and Colorado Deserts, since it is a much lower range than those to the north, is altogether arid, and separates two arid districts, offers in its numerous passes many facilities for the intermingling of two very similar floras. Hence the remarkable thing is that it *does* constitute a barrier over which a considerable number of plants do not pass, while a few, as at the passes of the higher mountains, slip over a very little way on either side through the low gaps. There is no plant more distinctly a member of the Colorado Desert flora than the Washington Palm, but at Twenty-nine Palms it has crossed to the Mohavan side of the dividing range [this would seem in line with the writer's opinion that Twenty-nine Palms is in the Mohave Desert]. . . As distinctly a Mohavan tree is *Yucca brevifolia*, the Joshua tree; but in this Twenty-nine Palms region it passes over the summit to the Colorado side. . ." Parish stated further: "*Yucca* has three species, one in both deserts and two confined to the Mohave;" the two species in addition to *Y. brevifolia* (which he stated grew in both deserts) must be *Y. schidigera* and *Y. Whipplei*, — for *Y. baccata* does not approach the Colorado Desert. The writer cannot agree with this statement for *Y. schidigera* is plentiful in both deserts; and *Y. Whipplei*, while not actually found on the flats of the Colorado Desert, extends to low elevations in the canyons and passes of the mountains bounding it on the west and northwest; it has been found and photographed on the mesas above Whitewater, presumably a part of the Colorado Desert, and in the pass leading from these mesas into Morongo Valley, — or considerably further west (and nearer the Colorado Desert) than *Y. brevifolia* which is not found further west in this region than the eastern end of Morongo Valley; *Y. Whipplei* is of course found well within the Mohave Desert, near Lucerne Valley for instance.

There are many specimens of *Y. brevifolia* from San Bernardino Co. in herbaria; most are from Hesperia but often "Mohave Desert" or "California Desert" is the only locality cited; the writer found it in fine fruit at the top of Cajon Pass, April 29, 1932, many clusters drooping outward from the base because of their weight; some were scattered on the flats between Victorville and Lucerne Valley, some between Lucerne Valley and Barstow. Dr. Jepson kindly sent (in litt. Nov. 18, 1936) some notes, taken from his field books, about the plant's occurrence; in San Bernardino Co. he mentions: the Ord Mts. (hills at Osborne's Camp), Coolgardie Yucca Mesa north of Daggett, Calico Mts., Kraemer. From Kern Co. about half of the few specimens come from around Mohave; the rest are from the Tehachapi region, from Walker Pass, and from between Weldon and Onyx; Dr. Jepson in his letter also cited "near Cameron station;" he wrote: "*Yucca brevifolia*, about Kraemer [San Bernardino Co.], Mohave Desert, and for 12 miles west [this would enter Kern Co.], stretching south into the Kraemer Hills, also southwest for about 8 miles into a rather dense forest, dense in the sense that in places the trees to the eye almost close the horizon. None about or west of North Muroc [Kern Co.] on the vast desert flats reaching towards Mojave sta. [Kern Co.] (that is about 8 miles from). Then

traveling west comes next, a 4-mile-zone (north and south), thence curving around to the north base of Soledad Mt. near (south of) Mojave sta. On the west of Mojave sta, a broad forest extending over the mesas to the base of the Tehachapi Mts. [Kern Co.] and on west, perhaps to the cluster between Fairmont and Neenach which is on the west edge of Mojave Desert." The last two stations are in Los Angeles Co. and so far as the writer knows are the only records from that county with the exception of Antelope Valley (also running into Kern Co.) and the Lancaster region where, 15 to 18 miles east, some extremely large trees are, or have been, recorded. Jepson's *Flora* cites the Joshua-tree from Owen's Lake, Inyo Co.; this would seem to be the most northern record to the west in California; Coville does not mention it from Death Valley nor does Merriam's Map 5, giving its distribution, place it in that Valley; he did state that E. W. Nelson reported it from the Nelson range (named in his honor by Merriam and separating the Panamint and Saline Valleys) where it stretches "all the way across from the Inyo Mountains to the Panamint Mountains;" these ranges lie considerably north and east of Owens Lake, the first bounding the Saline Valley to the west, the last running the length of the western side of Death Valley. Mr. Jaeger's handbook (California Deserts, 190. 1933) notes that "In its various forms it occurs through the mountainous areas of the Death Valley region. . . ." No specimens have been seen from this area.

In Nevada and in Utah the Joshua-tree, where the author traveled, was mainly represented by the variety and her records in these states are discussed under that plant. Merriam wrote little about the size and appearance of the Joshua-tree in these states although he several times refers to them as scattered and stunted; he did note that in the Charleston Mts. of Nevada (where on the east slopes the writer saw only the variety) "The individual trees are smaller than those of the Mohave Desert, rarely exceeding $4\frac{1}{2}$ meters (15 feet) in height." He reported the plant's occurrence in Nevada as follows: in Esmeralda Co., from as far northwest as Mount Macgruder; in Nye Co., "northeast of the north end of Oasis Valley . . . probably the northern limit of the species in this direction;" in Lincoln Co.,¹ at Point of Rocks near Pahroc Springs, in the Pahroc Range; he wrote: "These are the northernmost trees of which we have any knowledge. The high base level of Pahroc Plain explains the unusually high altitude at which they grow;" he referred to the west slope of the Highland Range as the most northern station in eastern Nevada; in Clark Co. he cited the west side of the Charleston Mts. Merriam mentioned many other localities but these, outlining the plant's range in the state, are the most noteworthy. Typical *Y. brevifolia* is represented by specimens from Goldfield (*Heller 10411a*), Esmeralda Co., not far from what Merriam mentions as its northwestern limit, and from near Ralston, Nye Co. (*Ferris, Scott and Bacigalupi 4051*). The writer found only the dwarf variety between the Searchlight Ferry and Las Vegas, in the Spring Mts. and in the Charleston Mts., — these regions extending from southeast to south, southwest, west and northwest of Las Vegas and all in Clark Co. Traveling from Las Vegas to St. George, Utah, the road runs in a northeasterly direction and, near Mesquite, leaves Nevada, crosses the northwestern corner of Arizona, and enters Utah near the Beaverdam Mts.; from about Glendale, Nevada (lying over midway between Las Vegas and Mesquite) to southwestern Utah, were found less stable plants, some suggestive of the typical form, others of the variety; this is the region (centering about Littlefield and lying north of and on the other side of the Colorado from Detrital Valley, Arizona) which has already been mentioned in discussing the plant in that state. About 10 miles east of Glendale (this is

¹ Lincoln Co. when Merriam wrote seems to have included Clark Co.; in citing Merriam's stations the writer has placed them as nearly as possible in the counties shown on recent maps.

not far probably from the "Desert near the Muddy and Virgen Rivers" where Parry collected it in 1874, — the typical plant was more common than the variety; northeast of Littlefield plants were scattered and poor and suggested both forms; they extended into Utah.

In Utah Merriam reported *Y. brevifolia* from the Beaverdam Mts., beginning at the foot of the west slope at 690 m. and extending, in a belt 5 or 6 miles wide, up to 1200 m. He noted the plants as more scattered than in the Mohave Desert and rarely exceeding 3 m. in height; this is in line with the writer's opinion that the variety, not the typical plant, predominates in southwestern Utah.

Merriam's records made on the Death Valley Expedition indicate that *Y. brevifolia* is found at the following altitudes: in California, from 750–1555 m.; in Nevada, from 1050–2135 m. (see reference to Pahroc Range above); in Arizona, from 675–750 m.; in Utah, from 700–1200 m. He made these general comments: "Tree yuccas are abundant about the borders of the Mohave Desert and on many of the included 'lost ranges,' and also in places of suitable elevation throughout the deserts of southeastern California, southern Nevada, western Arizona, and the extreme southwestern corner of Utah. They do not grow in the bottoms of the arid basins, or upon the steep declivities of the mountains, but thrive best on the higher gravel slopes that skirt the deserts and upon the basal slopes of the included desert ranges, always in a definite zone or belt the extreme vertical width of which rarely exceeds 450 meters (1,500 feet), and usually is much less. The altitude of this belt varies with the base level, but invariably marks the upper limit of the Lower Sonoran zone." In her travels the writer has, from afar, often mistaken large stands of mesquite for apple orchards, not only because of the form of these trees but because of their symmetrical and open spacing in the desert where insufficient moisture prevents a denser growth; Abrams (Bull. N. Y. Bot. Gard. 6: 320, 335. 1910) has commented upon the fact that the Joshua-tree bears the same resemblance.

With the possible exception of *Y. Whipplei* the Joshua-tree attracts more attention than any other yucca; its picture is frequently published and poems have been written upon it; a plant was even sent to the Century of Progress in Chicago (Desert Plant Life, 77, frontispiece, Sept., 1933) by "merchants and members of the newly organized Joshua Club of Victorville, California . . ." It is indeed a curious looking plant, suggesting, in its oldest forms especially, another age; one would not be surprised to see a huge prehistoric monster standing by and feeding upon the fruit on its upper branches; indeed, since the discovery that its leaves formed part of the food of the ground sloth just such a picture has appeared. There seems to be little hesitancy in referring to it as the "oldest living thing in the California Desert," and it may be; the writer has found no reliable data relating to its age.

A juvenile plant is unbranched (see pl. LXII); near the ground the bark may be visible, above are dead, reflexed leaves, above these is an elongated, encircling cluster of rather long, spreading or spreading-ascending green leaves; after a flower cluster has been produced at the top of such a plant two branches form just below it and grow at a narrow angle upward (see pl. LXIII); each of these branches when 0.6–1 m. in length, forks after flowering has occurred at its extremity and this forking habit is continued for the life of the tree; expressed briefly the plant is dichotomously branched with the flower-cluster terminal. "Middle-aged" plants because of this forking produce a dense, round- or flat-topped crown (the branches short and in close proximity); with age this crown becomes open and wide-spread (see pl. LXXII) for many branches do not survive, and those which do spread widely because of the weight at their extremities; pendulous ones are not uncommon (See Amer. Forests, 39, 13. 1933). An old tree has generally a single stem, — the

trunk short, stout, considerably and abruptly enlarged immediately at the ground; the bark is visible both on the stem and at the base of the branches and, as noted by Bigelow when the plant was first seen, it resembles that of the white oak. Occasionally several stems may be produced; one large specimen of this habit was photographed in the Sacramento Valley, Arizona, which had eight or ten stems, some 6 m. high (see pl. LXXI); in the pass between Morongo and Yucca Valleys, California, grew quite a number of plants of this clump habit but they were small; this shrub-like form was not seen within either valley. Trelease (l. c., 193, t. 9. 1893) wrote of the seedlings and root-system: "Seedlings possess decidedly glaucous flexible leaves, rather similar to those of young *Whipplei*. At first a fleshy round-pointed caudex develops below ground, from which long simple tough roots spread in all directions; but this original descending axis disappears with age, so that the old tree has a flat or irregular basal disk, from which the tough roots, now as thick as a lead pencil, run into the soil for a long distance." If one examines an overturned tree this flat disk-like base is seen to be encircled by a band of roots (the band about 45-60 cm. broad) of about the size described by Trelease; presumably their numbers, strength and symmetrical distribution around the base explain their ability to stabilize the very large portion of the tree which is above ground; despite the high winds of the desert one rarely sees an overturned tree. The uniformly pale blue-green leaves are tenaciously attached to the stem and to those adjacent and, because of this tenacity, their rigidity, exceedingly sharp spine and saw-toothed margins, they are painful to collect. As a bud the inflorescence suggests a large globe-artichoke (see pl. LXIV); Trelease aptly compares it in size to an ostrich egg; slowly it elongates somewhat, the large spongy, fleshy bracts curve outward disclosing at their base a thick bundle of marvelously interlocked flowers each protected by a small bract, — a work of art and symmetry as one discovers if one unfolds it part by part (see pl. LXV); eventually, when the branchlets have lengthened and the flowers expanded, the inflorescence forms a large, dense, ovoid mass about 30 cm. long (see pls. LXVI, LXVII); at this time all the large bracts, so conspicuous earlier, are, with the exception of those on or near the scape, completely hidden by the flowers; the whole is curious rather than beautiful in appearance, in color a greenish yellow. The inflorescence terminates the branch and therefore may be held erect, horizontal or pendent; its central axis is straight or may curve downward near the tip; the framework may persist for several seasons; the branchlets are short, stout, numerous; about 2.5 cm. in length at the base of the cluster, they become longer, some 5-7.5 cm. near the middle, and above shorter again; the tip of the inflorescence is racemose; on the lower part of the inflorescence the flowers are produced singly or in pairs, above there may be 7-9 flowers to a branchlet; of these two, at the base of the branchlet, have noticeably longer pedicels than the rest; on the racemose tip the flowers again appear in pairs or singly. The large bracts at the base of the branchlets are at first of the texture of a thick chamois and are tinged with "ashes of roses," rarely with darker reds and purples; at anthesis they are already dry and brittle, gray or whitish, but they persist and, especially near the base of the inflorescence, are conspicuous when the cluster is in fruit; the bracts at the base of the pedicels are at first of the texture of a thin suède but soon dry and become very fragile. The flower-bud (see pl. LXV), slender at the base, is much thickened and more or less 3-sided at the apex where the thickened, hood-shaped portions of the segments are tightly appressed; at anthesis the lower portions of the petals bulge and the upper portions spread or reflex and protrude between the rather flaccid sepals; though appearing longer the sepals are as a rule actually shorter than the petals at this time; all segments are long, narrow, fleshy, progressively thickened from about the middle upward, very brittle and readily snapped; they are fairly uniform in form and size on all flowers and indeed on all plants. The fila-

ments are extremely small and at anthesis scarcely reach to the middle of the ovary to which they are closely appressed, only occasionally and at the middle bulging away from it; at anthesis their lower portion is hard, resilient, the clavate tip nearly globose. The ovary is nearly always ovoid, stout below, and marked clearly and conspicuously with the enlarged impress of the anthers; the extremely short style¹ is similar in all respects to that found in other yuccas; the stigmas also, — each erect, for its size fleshy and with a minute cleft at the apex; the stigmatic-opening is large considering the size of the style. Fruit is often plentifully produced, at times nearly universal on all plants and all clusters well-filled; references to its scarcity indicate that the writer may have been unusually fortunate. Fruit develops near the base of the inflorescence while the upper part is in flower and is often of good size before all flowers have gone by; sometimes it disintegrates rapidly, again it may persist for a long time; on a single cluster 25–40 fruits are not unusual; the pedicels are spreading and each fruit stands out as an entity (see pls. LXVIII, LXIX) upon the well-filled, nearly ovoid clusters. (In other yuccas with baccate fruit the pedicels are eventually decurved and the fruit pendulous, in those with capsular fruit the pedicels are nearly erect and the fruit upright.) In form the individual fruit shows more variation than might be expected because of the nearly always ovoid ovary; although it is not distorted or constricted it may be ovoid, obovoid or nearly ellipsoidal; the persistent style and stigmas (still in good condition) give the appearance of an extremely short mucro at the tip of the acute or rounded apex; the stigmatic opening often remains unclosed on the developed fruit; in size the fruits vary little, 7.5–10 cm. about the minimum and maximum length; the corolla-segments and stamens (now considerably enlarged, thickened and hardened at the base and shrivelled above) are long retained in their entirety, at first erect as in the flower, eventually reflexed. Parish (Gard. & For. 4: 135. 1891) wrote of the fruit of *Y. brevifolia*: "Although truly indehiscent, the ripe fruit manifests a tendency to the capsular structure by the replacement at what would be the dissepiments of the thick texture of the pericarp by a thin membrane, which occasionally splits. They are opened by birds, which are perhaps in search not so much of the seed as of the larvae which abundantly infest them . . ." Trelease wrote (1893): "As in all of the Yuccas, the maturing fruit develops a rather firm but thin core-like endocarp immediately surrounding the seeds, but in this species the thick exocarp, instead of becoming pulpy as in the baccate species, or hard as in the dehiscent capsular section, assumes a spongy texture. The ripe fruit, readily breaking from the tree, consequently possesses large bulk and low specific gravity." And later in the same paper he stated of the seed's dissemination: "The fruits of this species fall quickly after ripening, either by a distinct disarticulation or because of the brittleness of the pericarp at base, and their rounded form and very light specific gravity render them well developed 'tumble fruits,' and point to their dissemination over the dry sands of the desert by aid of the strong winds which prevail there, the seeds being liberated ultimately by the breaking of the fragile pericarp. Although *brevifolia* appears to be the least advanced of the Yuccas in its general development, I am disposed to look on this adaptation of its fruit to wind dissemination as a special acquisition, rather than regard it as representing the original type of Yucca fruit; yet, so far as the facts are known, it might equally well be held to be an advance on an earlier unspecialized fruit, or a retrogression from the baccate type."

Yucca brevifolia appears to be stable and fewer abnormalities were found in its flowers than in those of the Baccatae and Treculeanae series; on one plant (McKelvey 2544) they

¹ Rydberg (Flora Rocky Mts., 169. 1917) notes "Styles wanting" in *Clistoyucca*; the writer has found the style present although extremely short.

were present, principally on those flowers at the base of the branchlets; one flower had 3 pistils united for their entire length and 13 stamens; another had 2 pistils similarly united and 8 stamens; still another 2 pistils, united only at the base, 12 stamens, 10 perianth-segments.

The species at times grows with *Y. schidigera* and their flowering seasons overlap; no plants seen, however, suggested hybridity. Trelease, writing in 1893 of the moth which frequents *Y. brevifolia*, stated: "Unlike the other known species, this *Pronuba* appears slow to take flight. Though it is easily disturbed, so as to run about and seek concealment between the flowers, I have seen it take to the wing only a few times, and then it merely sailed down to the ground, not far from the tree. This apparent indisposition to leave the flowers may, perhaps, be connected with the almost constant occurrence of high winds on the desert. Whatever its cause, this habit of the moths appears to restrict cross-pollination to flowers of the same plant more closely than is the case with other *Yuccas*, though there must be frequent flights from plant to plant in quiet weather, and especially at night, when the wind sometimes falls; and the development of the stigma two days in advance of the stamens of a given flower, renders close fertilization in the strictest sense improbable."

The size of the Joshua-tree may easily be overestimated. Sargent (Gard. & For. 8: 302. 1895) gave its height as 30-40 ft.; Jepson (Fl. Calif. 1: pt. VI. 314. 1922) noted "commonly 16-30 feet high;" there are (one might perhaps say have been) exceptional trees but 30 ft. would seem to cover the average large specimen. Horlick (Jour. N. Y. Bot. Gard. 33: 249. 1932) wrote: "The ages of certain individual trees have been estimated at approximately 600-800 years. The age of the largest one known, located about eighteen miles east of Lancaster, in Antelope Valley, was estimated at 1,000 years or more. It was eighty feet in height and nine feet in circumference [?]. Three days ago I received from Mrs. Hoyt . . . a newspaper clipping of an illustrated article relating to this particular tree. An excerpt . . . is as follows: 'Mrs. Sherman Hoyt, President of the International Desert Conservation League, has announced that a \$100 reward will be paid by the League for the arrest and conviction of the persons who wantonly burned the giant Joshua tree on the desert near Lancaster two weeks ago. Something of the enormous size of the tree is gained by the fact that the trunk was still burning when a photographer representing the League visited the scene a week after it was set on fire.*** The deserts of this section are among the few places in the world in which the Joshua trees grow.*** Nobody paid much attention to the Joshuas until lately*** As soon as they began to realize their beauty and unique character, there began a wholesale foray into the desert to dig them up*** At the present rate of destruction the cactus of the desert and the Joshua tree will be gone within two years' . . ." Trees of such size are uncommon. Six years earlier one had been illustrated and discussed (Kew Bull. Miscel. Inform. 1926: 49, tt. 5, 6); the article quoted information given by Mr. Ernest Branton of Los Angeles, who took the photographs; the tree grew 15 miles east of Lancaster, Los Angeles Co., and was reputed to be one of the largest in existence, its height 18.5 m., its girth, at 0.6 m. above the ground, 6 m.; among the photographs at the Arnold Arboretum are five of this tree, taken by Branton in July, 1925; the trunk was apparently hollow since one picture (taken from the side) shows a large hole; it grew in Antelope Valley; the girth of the trunk at the ground was 7.3 m.; in the same collection are two good photographs of juvenile trees. Another article by Branton (Jour. Intern. Gard. Club, 3: 567, 3 tt. 1919) includes three pictures, one, certainly, is of the tree described in 1926 in the *Kew Bulletin*; its height is given as 19.5 m. [which would mean a growth of 1 m. in some 6-7 years], the diameter of the trunk (at 1.5 m. above the ground) 1.5 m. Branton mentioned the uses made of the wood of the

Joshua-tree and stressed the need for protection; of its propagation he stated: "The writer does not know of one in cultivation, though they may easily be started from seeds for it has been done many times; but the seedlings do not long endure the loving care of man. The writer has brought scores, in varying sizes, from the Mohave Desert, but never succeeded in successfully transplanting a single one, nor does he know of anyone who has. . . ."

Many common names have been given *Y. brevifolia* but the most popular is Joshua-tree; the name Joshua appears in many combinations and corruptions, Joss, Josh, Joshuyucca, Joshua-yucca, the Joshua, etc.; and its origin has been variously explained; Coville refers to it as one by which it "is rather jocularly known;" Jepson (*Trees of Calif.* 84. 1923) writes: "The sense of reverential awe exerted by these desert yuccas upon the mind of the Mormon settlers in Utah found expression in their folk-name Joshua Tree . . ." Bonker and Thornber (*Sage of the Desert*, 58, t. 1931) state: "Not every traveller knows that Joshua, seeking the Holy Land, travel wearied, tired after a long dusty trek, looked forth to high Heaven for a sign which would tell him the right road to take. Guidance came instantly. 'Thou shalt follow the way pointed for Thee by the Trees. And Thou shalt enter in.' Be it noted that the Joshua Tree points its branches usually in one direction, its spears appearing almost like arrows poised for flight (One of the versions from which the name Joshua Tree has sprung)." No reference for the citation included in this quotation is given; unfortunately it does not seem to the author that the branchlets, even "usually," point in any one, but rather in all, directions. Jepson's explanation appears to be the most plausible, the name one of folk-lore, originating among a people familiar with biblical history. It is also known in California as yucca-cactus and tree-yucca; the writer has found that many persons think of the yucca as a cactus (on the general principle presumably that all spiny desert plants are such), — that it belongs to the lily family is always a surprise; the name tree-yucca might lead to confusion with *Y. schidigera*. Mr. E. C. Jaeger (*California Deserts*, 190. 1933) notes "As was the case with the Washingtonia palm, this yucca was given the name of cabbage tree by the pioneer travelers, and today is often erroneously brigaded with the palms under the name of 'yucca palm.'" See also Sudworth (*Miscel. Circ.* 92, U. S. Dept. Agric. 49. 1927) and Britton and Shafer (*N. Amer. Trees*, 150, fig. 111. 1908).

Of animals frequenting the Joshua-tree H. J. Webber (*Rep. Missouri Bot. Gard.* 6: 107. 1895) wrote: "Dr. Merriam mentions the reflexed leaves of *arborescens* (*brevifolia*) as effectually preventing most animals from climbing up the trunk from below. Dr. Merriam informs me, however, that the wood rat succeeds in ascending the trunk. I quote the following from a letter of February 6th, 1894: 'Mr. Vernon Bailey and I have examined many trunks of the tree Yucca (*Y. arborescens*) which had been ascended by a small desert mammal known as the wood rat (*Neotoma Mexicana*). The wood rats cut off the leaves of the Yucca at the base and thus form a spiral groove or ladder around the trunk. The leaves are used by the rats in the construction of their bulky nests which are commonly made up of spiny materials such as sharp splinters of rock, parts of cactus, leaves of Yuccas, branches of spiny desert shrubs and the like. The heaps of rubbish thus formed over the mouths of their burrows constitute a protection against coyotes and other enemies.' This wood rat which is the only animal known to ascend the Yucca trunk, may not have as its main object the fruits to be found there. Dr. Merriam informs me that he has found freshly cut leaves at a time when there were no fruits on the plant. They may merely desire the leaves for their nests or may feed on the tissue of the base of the leaf . . ."

J. Van Denburgh (*Occas. Papers Cal. Acad. Sci.* 10: 1922) wrote of the Desert Night Lizard (*Xantusia vigilis* Baird) which frequents the Joshua-tree: "About a mile from the

station at Mohave there is a considerable forest of *Yucca arborescens*. The many trees and wind-broken branches, which lie decaying on the ground, afford a home to numerous colonies of white ants, scorpions, vicious looking black spiders, and several species of beetles. In a deep crack of one of these branches a small lizard was discovered, which when caught, proved to be a young *Xantusia vigilis*. Probably it had not yet learned how to hide from the day, for I have never seen another undisturbed individual. The key to their home once discovered, the collection of a large series of these lizards was merely a matter of physical exertion. Every fourth or fifth stem that was examined gave up its *Xantusia*, and in one instance five, as many as were previously known to collections, were found under a single tree. Most of the lizards were found between the bark and the ground, but many had hidden in the thick clusters of dead leaves, from which it was very difficult to dislodge them. When first exposed to the light, they were dark colored, and seemed dazzled for a moment, during which they made no attempt to escape. They were not at all sluggish, however, and, if not caught immediately, made for the nearest cover as fast as their very short legs would permit. This cover was often the collector, and the little lizards either hid under his shoes, or climbed his legs, sometimes even reaching his shoulders. They showed no desire to enter the numerous holes in the ground about them, or to escape by burrowing. Put into a glass bottle they became very light colored in a few minutes, but began to turn dark again immediately after sun down. Young were numerous and remained dark longer than adults. Many fragments of cast skins were found, but never a whole skin in one place. The stomachs of several individuals contained the wings of some small dipterous insect, the elytra of a little brown beetle, and some small white bodies which resembled spider's eggs. Several specimens were taken alive to Leland Stanford Junior University, and kept for some months in a large glass jar in which some fine sand and pieces of wood and bark had been placed. At first, they ventured out from their retreat only at dusk unless disturbed, but after a few days they seemed to become more restless, and, urged perhaps by hunger, showed themselves many times each day. At night, when they were always more active, they often climbed to the top of a piece of yucca stem placed upright in the middle of their cage. No desire to burrow was observed. All declined to show any interest in the small beetles, and flies, both dead and living, which were placed in the jar, and finally became greatly emaciated. Mohave was visited again in the fall of the following year. The specimens were all caught alive and put into a large glass bottle, but were soon killed by the heat, although care was taken to keep them in the shade as much as possible. Count was kept as the lizards were put in the bottle, and showed later that several more were taken out than had been put in. This may have been due to a mistake in the record, but was more probably caused by the birth of young after capture. The adults were afterwards carefully examined and three were found to contain young, showing that the species is ovoviviparous. One of the three contained two foetuses, the others have one apiece. The foetal specimens are about the size of the young found under the dead branches. They were taken on the 17th and 18th of September. At Cabazon, Riverside County, I found one in a growing tree yucca of a smaller species, and at San Matias Pass, Lower California, Heller found this lizard beneath the prostrate limbs of a yucca." Mr. Van Denburgh records the species from Kern, Inyo, Los Angeles, San Bernardino, Riverside and San Diego Cos., in California, from the Pahrump Valley in Nevada and from Lower California. The writer collected this lizard in the winter of 1935-1936 in Morongo and Yucca Valleys; most dead trunks sheltered them and their capture was very easy. Van Denburgh wrote also of the Desert Scaly Lizard (*Sceloporus magister* Hallowell) which, at times, is found in the shelter of the yucca but no species is mentioned.

Of certain insects utilising this species of *Yucca* E. C. Jaeger (California Deserts,

190. 1933) has written: "The two chief causes of branching of the tree yucca appear to be the dying of the terminal buds after flowering and the injury caused by the yucca-boring weevil (*Scyphophorus yuccae*). The larvae of this beetle, when ready for pupation, build in the ends of the branches peculiar, tough cases of frass, as the chewed-up, fibrous refuse from boring insects is called. The so-called petrified wood, so much prized as fuel by desert settlers, is made by the plant as it lays down silica in the cell walls in its attempt to wall off the injuries done by the borers, by fire, or by wind. This tree propagates itself by means of seed and by sending out long, underground runners. We are especially interested in the young plants which spring from the runners, for it is upon these that the Navaho yucca borer (a butterfly, *Megathymus yuccae navaho*) lays her large eggs. When these hatch, the energetic larvae bore into the young plants and make their way to the large underground stems, where they feed and later pupate. Now the female butterfly seems to know that if she lays her eggs on the small-rooted, small-stemmed plants which spring from seeds there will be no food there for her larvae. In some uncanny way she is able to distinguish between the seedling plants and the runner plants — a distinction which man cannot readily make! Because the plants of runner origin alone are suited to her needs, the female, so far as is known, never lays her eggs upon the seedling plants." See also Comstock and Dammers (Bull. So. Calif. Acad. Sciences, 33: 79-92. 1934) concerning this species and *Megathymus Stephensi* Skinner.

Laudermilk and Munz (Contrib. to Palaeontology, IV., in Carnegie Instit. Wash., Publ. No. 453, 1934) have shown that the ground-sloth fed mainly on the Joshua-tree. The introduction to their paper states: "Gypsum Cave is situated some eighteen miles east of Las Vegas, Nevada, at an elevation of 1500 feet and is surrounded by a typically sparse desert flora. During the years 1930 and 1931 the cave was systematically excavated . . . Among the organic remains uncovered were parts of skeletons, desiccated hide, hair and other integumental structures of the extinct ground-sloth, *Nothrotherium* . . . several layers of dung were noted, overlying and intermixed with the sloth remains. . . Identification of the plant tissues in the sloth dung seemed particularly desirable in order to answer two questions: (1) What was the flora of the region at the time the sloth inhabited the cave, and (2) does the identification of the flora cast any light on the climatic conditions at the time the ground-sloth lived? Some identifications of the plant remains comprising the sloth dung were presented by Dr. Arthur D. Howard in Mr. Harrington's book [Southwest Museum Papers, no. 8, 193-194. 1933] . . ." Dr. Howard's list includes the Joshua-tree, — "Recognized by chitinous saw-tooth leaf edges. Also represented by much fibre, some attached to epidermis . ." Volumetric determinations ". . . indicated that fully 80 per cent of the material consisted of yucca . . ." Under the section "Study of existing floras," it is stated that the authors in 1933 collected specimens in the vicinity of the cave and in the Clark Mts. of California, about 42 miles southwest; the elevation here was 1500 m.; "The plants collected in this locality represent, in most cases, types which prefer a higher altitude and more abundant rainfall. *Yucca brevifolia* (Joshua tree), *Yucca baccata* (blue yucca), *Agave utahensis* (mescal) and *Ephedra nevadensis* (Mexican tea) were among those obtained. With the exception of *Ephedra*, which flourishes at both localities, none of this group grows in the vicinity of the cave at the present time . . ." The article states that "The alcoholic material was brought to the laboratory for study, and both microscopic and macroscopic methods were applied." After describing the methods of study in detail and the results arrived at, the article concludes: "All the foregoing evidence indicates that *Nothrotherium* was preeminently a yucca-feeder, while living in the vicinity of the cave. Other plants were eaten, but only secondary to the yuccas and plants of the same type . . . *Yucca brevifolia* and *Agave utahensis* are not found near the

cave at the present day, but are common in the Clark Mountains and other high localities where less arid conditions prevail. With the exception of the yucca with jigsawed serrations, the plants so far identified are all of well-known types. There is every reason to believe that when one views today the vegetation of the Clark Mountains (Plate 11), one sees the same type of plant environment in which the ground sloth lived when it inhabited Gypsum Cave. In general, the plant assemblage represented in the sloth dung is found today only at elevations 3000 or more feet higher than Gypsum Cave. In other words, at the time when ground sloths, and perhaps man, inhabited Gypsum Cave, the climate was distinctly more humid than it is today. Whether that moister age was Pleistocene or Recent remains an open question." The photograph (t. 11) shows a "View of a typical landscape in the Clark Mountains, California . . ." The Joshua-trees in the foreground are noted as "large;" from their habit they would seem to represent typical *Y. brevifolia* although the region is one where the variety is believed to prevail. More recently other sloth caves have been investigated in the Grand Canyon region. The rotogravure picture section of the N. Y. Times (November 14, 1937) included a picture of the "Great Sloth" standing by a Joshua-tree; it will be interesting to learn whether, in this region, *Y. brevifolia* formed part of its food.

At one time the Joshua-tree was used in the manufacture of paper pulp. An unsigned article (Gard. Chron. n. s. 26: 18. 1886) states that "An English company started in San Francisco for the purpose of converting the *Yucca brevifolia* into paper pulp, has, it is said, suspended operations for the present, the venture having proved unsuccessful. Notwithstanding the failure of this company, it is confidently stated that the business can and will yet be made to pay handsomely." Later (Gard. Chron. ser. 3, I. 772, fig. 145. 1887) we are told that this pulp was used for "paper stock for the London Telegraph." Branton (Jour. Intern. Garden Club, 3: 567. 1919) explains that the pulp, sent to England, "heated on the way and was spoiled. It seemed impossible to prevent the heating and the cost of harvesting was so great that the enterprise was abandoned." It is fortunate that the optimism felt as to the ultimate success of the industry proved unwarranted! (The illustration in the *Gardeners' Chronicle* of 1887 shows a tree in the Mohave Desert; its long trunk had been bent over until the uppermost branches reached the ground; here they had become, naturally or by human hands, fastened; from the top of the arched trunk a tall stem grew upward. One of the author's photographs shows six adventitious branchlets sprouting from an old branch; see pl. LXXX).

Shinn (Amer. Agriculturist, 50: 689, figs. 1, 2, 3. 1891) has written at length of this paper industry: ". . . About twenty years ago some experiments led people to put faith in its [the tree's] value for paper-making. The proprietors of the London *Daily Telegraph* were finally induced to invest in the process, and they built a mill on the Colorado river to work up pulp from yucca stems and leaves. A large amount of paper was manufactured and shipped to England. I believe that a few editions of the *Telegraph* appeared on this fabric, and I know that some of it was tried in New York and San Francisco. The supply was very large, but the cost of manufacture proved to be greater than the projectors of the enterprise expected. After shipping large quantities of both white and brown paper the mill was closed, and has been started up once only or twice since. The time for yucca paper has not yet come . . ." The photographs of the Ravenna mill, accompanying the article, do not indicate a thriving business. There are two sheets (M 140134, 140135) bearing samples of paper made from the Joshua-tree, presumably at this mill although that is not stated. See Dodge in *U. S. Dept. Agric. Fiber Investigations Report*, no. 9, 1897.

Other ways of exterminating the tree are described in *Land of Sunshine* (10: 3 figs. 1898). While a footnote at the end discloses that the article was an advertisement, yet it

contains considerable information and since often cited and not readily accessible, it may be well to quote from it here. A Mr. Densmore evidently procured a patent permitting him to control the manufacture of surgeons' splints made from this *Yucca*; because "lighter than any other wood of sufficient strength" and because of its porous character (allowing "free circulation of air to the fractured part and the use of antiseptics without removal of the splint") it was considered advantageous; like felt it could be cut readily with scissors, but, "unlike felt, it does not lose its supporting qualities when wet." The product was put on the market in the form of splints and of sheets, "at about twenty cents a surface foot, and needs only to be immersed in tepid water and bandaged to the limb, when it retains the form thus given it." Also: "*The supply of yucca is limited*. Nine-tenths of it comes from the Hesperia district, but it is also found in such other southern California localities as Lancaster and Palmdale, and is a unique feature of the Mojave desert [*italics mine*]. The trees are cut into lengths of from 18 to 30 inches, peeled off the bark and shipped to the only yucca factory in existence, established in Los Angeles by Messrs. Densmore, Means & Fleming in 1893. Here the log is placed in a rotary veneer lathe and, while it revolves, the log is reduced to the size of the four-inch dogs which hold it. When dry . . . the sheets are carefully assorted. The blemished sheets are laid aside to be used to protect trees from such pests as rabbits, while the finer pieces, after being put through a sandpapering process, are carefully packed for market. The peculiarity of the wood is that it does not split, and its pliability and lightness admit of the sheets being rolled and sent through the mail. Its durability and uniqueness make it of exceptional value for covers for booklets, while its beautiful grain renders it appropriate for art work in oil or water colors, pyrography, silk embroidery and for fancy work, such as photograph frames, glove and handkerchief boxes, screens, etc. . . ." The three pictures in the article illustrate some of these goods; one shows a booklet, its covers made from the Joshua-tree and decorated with a cowboy beneath a Joshua, his lasso forming the words "Land of Sunshine;" another piece of the wood, entitled "The Yucca in Art," bears a picture of some yucca fruits scattered about a bowl of unstable appearance; the article concludes thus: "The evolution, in the hands of the Yucca Manufacturing Company, of this once despised desert tree into so many useful and artistic purposes is eloquent of what ingenuity and enterprise may yet accomplish with other seemingly useless material in Nature's storehouse." One can but hope that this tree, which contributes so much to the desert landscape, may be protected before it is entirely confined to "useful and artistic" objects on a store shelf! The *Joshua Tree National Monument* is a fine step in the right direction. One of the booklets mentioned is still to be seen (M 140145); also a sheet of the wood (140131); on the last Dr. Trelease noted that it came about a bundle of plants, — "splint material for wrapping live plants."

Palmer (Amer. Naturalist, 12: 647. 1878) wrote: "The leaves of this plant [*Y. brevifolia*] are short, and not useful for Indian purposes, but it produces abundance of large seeds which contain nutrition; they are ground fine, and either eaten raw or cooked in the form of mush by Southern California Indians . . . Not only is the leaf fibrous, but the body more so. As raw material for paper it is excellent."

Yucca brevifolia* var. *Jaegeriana McKelvey in Jour. Arnold Arb. 16: 269, t. 139 (April, 1935).

Yucca brevifolia var. *Wolfei* Jones, Contrib. West. Botany, no. 18, 125 (April, 1935).

Plant 3–3.6 m. in height, very rarely 6 m., with short, stout (compared to that of typical plant more slender) stem, branching at 0.75–1 m. above ground; branches short, rarely spreading, commonly erect or erect-ascending; crown except on extremely old

specimens dense, compact, round-topped; bark much broken, unevenly fissured, rough. Clusters of leaves 30–60 cm. in length, dense, symmetrical, neat rather than shaggy; reflexed, dead leaves at base of branchlets and on trunk closely and neatly appressed. Mature leaves short, commonly 10 cm. in length including base, not exceeding 22 cm. (length, including base, of shortest of typical plant), straight, scarcely if at all constricted at union of base and blade. Inflorescence about 30 cm. in length overall (scape 5 cm. in length, 2.5–3.2 cm. in diameter at base). Flowers and fruit characters as in typical form.

Range. Extending from northeastern San Bernardino Co., California, where it is plentiful in the region of the Shadow and New York Mts., due east across southern Nevada to the Colorado River and northeast across the southern part of that state into extreme northwestern Arizona and southwestern Utah. For range map see p. 121.

CALIFORNIA. San Bernardino Co.: Vicinity of the Shadow Mts., about 1200 m., April 30, 1932, *McKelvey* 2732 (AA: **type**). — Road from Barstow to Las Vegas, near Yucca, April 30, 1932, *A. Eastwood* 18790 (CA). — Cima, March 16, 1932, *E. C. Jaeger* (PO).

NEVADA. Clark Co.: Between Colorado River and Searchlight, about 1200 m., May 1, 1934, *McKelvey* 4094 (AA). — Desert near Yellow Spring Mine, Spring Mountain Range, alt. about 1500 m., May 3, 1934, *McKelvey* 4142 (AA). — West slope of Charleston Mts., spring of 1934, (collected by *Little*) *McKelvey* 4951 (AA). — East slope of Charleston Mts., May 2, 1934, *McKelvey* 4097, 4098, 4099, 4100, 4132 (AA). — Kyle Canyon, Charleston Mts. Gravelly soil. Juniper belt, alt. 1800 m., April 21, 1937, *I. W. Clokey* 7475 (G). — Southern Utah [=Nevada?], Desert near Muddy and Virgin Rivers, 1874, *C. C. Parry* 257 (M). — Southern Utah, 1874, *C. C. Parry* 257 (G) (P).

ARIZONA. Mohave Co.: Twelve miles northeast of Beaverdam, alt. 1350 m., April 4, 1894, *M. E. Jones* 5008 (W); Four miles west of Copper Mine, alt. 1350 m., Utah gravel, April 4, 1894, *M. E. Jones* 5008 (PO) (M). — Four miles northeast of Littlefield, May 4, 1934, *McKelvey* 4160 (AA).

UTAH. Washington Co.: St. George, 1869, *J. E. Johnson* (M; with Parry note attached) (G). — Southwestern Deserts [St. George, Utah, scratched through], 1869, *J. E. Johnson* (W). — Southern Utah, 1875, *Palmer* (W). — Beaverdam Mts., May 8, 1874, *C. C. Parry* (ex herb. Engelmann) (UC) (AA).

This variety was described by the writer in 1935 and was named for Mr. Edmund C. Jaeger of Riverside Junior College. He wrote (in litt. Oct. 2, 1934) that the distribution of the variety "reaches its greatest density in the vicinity of the New York Mts., of California."

The writer has not visited this range; she made her first collections and studied the plant somewhat northwest, in the region south of the Shadow Mts., northeastern San Bernardino Co.; this was chosen as type locality. The type (*McKelvey* 2732; herb. Arnold Arboretum) represents fruit, foliage, flowers (these had fallen from the trees and although much shrivelled were perfect in all their parts), and miscellaneous material, bark, etc.; many photographs were taken in the region (see pls. LXXIV, LXXV). The variety is primarily distinguished from the better-known plant by a dwarfer, more compact habit; all plants at the type locality show this habit.

In P. A. Munz's *Manual of Southern California Botany* (95, April 3, 1935), is noted under *Y. brevifolia*, "Cf. var. **Wolfei** Jones. Leaves short. E. Mohave Desert." The reference is to Marcus E. Jones, *Contributions to Western Botany*, no. 18, p. 125 which, according to Dr. Munz (in litt. Dec. 10, 1937), was "printed before June 3, 1934 but not distributed until April, 1935." The Jones reference reads: "*Yucca brevifolia* var. **Wolfei** n. var. At Yucca Grove and Mountain Pass on the Arrowhead highway are immense numbers of a yucca having small and oblong-ovate heads about 6 inches by a foot long, of flowers, which are sessile at the ends of the branches, the white flowers are 2 inches long, with the linear-lanceolate petals 2 mm. thick; stamens with globose anthers; odor carrion-like; leaves 4–6 inches long and very sharp-edged and short-pointed with a black spine. The stems are more slender than the type and have many more slender branches and with

trunks rarely 3 ft. through. Named for Mr. Wolfe of the Santa Ana ranch who first noted it." Dr. Munz wrote "I suppose this is the same as your variety and that your name is valid, since Marcus [Jones] has no Latin diagnosis, cites no type, etc., etc." Mountain Pass lies to the north of the Ivanpah Mts. and Yucca Grove is presumably the "Yucca station" of most maps; both lie along the Barstow-Baker-Las Vegas road (presumably the "Arrowhead Highway" although the writer is unfamiliar with that name); this is much the region of the type locality and Jones' variety and the writer's are undoubtedly the same.

The largest, oldest trees at the type locality did not exceed 4.5 m., most were only 3-3.6 m. tall; plants of only 1-1.15 m. were often much branched and despite their miniature size looked like old trees. The trunk was short, thick (although in proportion to the size of the tree more slender than on the typical form), and began to branch at 0.75-1.0 m. above the ground; the bark was generally visible. The branches were covered with reflexed, closely appressed dead leaves near the base, and terminated in symmetrical clusters of short, rigid, blue-green leaves, these clusters 0.3-0.6 m. in length; they were erect or erect-ascending, even those on old plants scarcely spreading at all. The leaves were straight, rarely falcate; none exceeded 22 cm. in length (base and blade), and most were only about 10 cm. long (the longest of the variety seem to approximate the shortest found on the typical plant); the base of the leaf was slightly broader than long; the blade tapered gradually from union with the base to the apex; the somewhat abrupt constriction just above the point where base and blade unite seemed to be less pronounced than on the leaves of the typical form.

On April 30, 1932, there was much fruit in the region. The panicle, scarcely 30 cm. long, was entirely exserted; the scape was about 5 cm. in length, 2.5-3.2 cm. in diameter, the inflorescence proper about 23 cm. in length, the branchlets 2.5-4 cm. The fruit was oblong-cylindric or slightly obovoid, the apex acute or flattened and tipped by the very short persistent style and stigmas (still in good condition); the stigmatic opening, which was large considering the size of the style and stigmas, was for the most part unclosed (see pl. LXXIX); each fruit was plump throughout and the secondary fissures were nearly if not quite obliterated; the primary fissures near the top were rather deeply cleft, below were indicated by shallow concavities about 1.2 cm. in breadth and marked by cross fissures; the lobes between the fissures were flat to rounded and often marked from base to near the middle by the greatly enlarged impress of the anthers; the fruit was about 7.5-10 cm. in length, 4.5-5.7 cm. in diameter and was rarely contorted or constricted. Many dried flowers lay upon the ground and were intact in all their parts; they indicated a possible distinction in form of style and character of perianth and the filaments seemed to reach a little higher about the ovary than those in the typical plant; but shrinkage may have varied in the different parts of the flower and they should be studied in fresh condition.

On May 1, 1934, the writer crossed the Colorado by the Searchlight Ferry, leaving Arizona and entering southern Nevada; on the climb from the Colorado on the Nevada side this variety was found again at about 1200 m.; the plants probably extend here from the vicinity of the New York Mts. not far west. Some trees looked older than those at the type locality and, exceptionally, attained greater dimensions; one specimen (see pl. LXXVII) was 6 m. tall but, despite its height, did not resemble the typical plant for its appearance was far neater and more compact, — the reflexed, dried leaves closely appressed about the branches and upper part of the trunk, the green leaves forming dense symmetrical heads; also the branches were erect and showed no tendency to spread or become pendulous. Old inflorescence stalks persisted from earlier years and most curved downward near the tip; they were 20-35 cm. long with a thick, extremely short to negligible scape; the basal branchlets were 2.5-7.5 cm. long, shorter upward; some inflorescences

were nearly racemose. The leaves did not exceed 20 cm. in length and most were much shorter. The plants must have flowered poorly and the only fruit seen, near Searchlight, had largely disintegrated. There were many plants about Searchlight and to the east could be seen extending to the tops of the low mountains fringing the valley in that direction, possibly reaching 1700 m. Northward the plants extended to near the junction of the Las Vegas and Nelson roads.

On May 2, 1934, the east side of the Charleston Mts. was visited; starting from Las Vegas, where the altitude was 600 m., the road left the desert at 900 m. and ascended to Charleston Park situated at an altitude of 2450 m. The Joshua-tree began at 1050 m., was very plentiful at 1700–1800 m., and extended to 2000 m. where plants were more scattered. Fruit was present in great quantities, the writer had never seen so much on any other species (see pl. LXXVIII). Curiously, Mr. Little who, through the kindness of Mr. Jaeger, obtained flowers for the writer on the west slope of these mountains in the same year, reported that there had been little flowering on that side. On many plants which had not developed fruit all the dried flowers still remained closely packed in the clusters, only falling when these were handled. While some large old plants were seen only the variety was represented in the region. Coville noted that the tallest tree seen on the Death Valley Expedition was found "on the western slope of the Charleston Mts. . . ." It was, however, only "7.9 meters high," about the size, therefore, of the one noted near Searchlight. The fruit in the Charleston Mts. varied in form and size; it was mostly obovoid, rarely oblong-cylindric; it was tightly packed into the egg-shaped cluster, the crevices often filled with dried bracts and flowers; a globular exudation (like small bubbles) was not uncommon on the fruit (see pl. LXXIX). In this region the Joshua-tree was associated with *Y. schidigera* at altitudes of 1050–1700 m., the last-named beginning lower but not extending so high as the first; it was associated with *Y. baccata* from 1500–2000 m. but began lower and did not extend so high as that species. For some distance it grew in association with junipers and pinyon pines. Further south in Nevada this variety was seen near the Yellow Pine Mine in the Spring Mountain Range, close to the California line; plants began, scattered and stunted, in the desert at 960 m. but at 1450 m. became more numerous and improved in appearance; here again they were in fruit. At intervals from Las Vegas into southwestern Utah the Joshua-tree is found; while the variety is the common form there are many which resemble the typical plant (see pp. 129, 130). In the Beaverdam Mts., with juniper, pinyon and *Y. baccata*, it was found at the top of the divide crossed by the main road to St. George, at about 1350–1500 m. elevation. Merriam stated that in these mountains the plants rarely exceeded 3 m. in height; it was difficult to tell, at times, whether the typical plant was stunted or whether the variety was represented; both forms occur probably, and intermediates.

To outline the range of the variety as understood at present: from about 15–20 miles northeast of Baker it extends east across California and enters Nevada in the Searchlight region; its southern limits in California are not known but, as stated in discussing the early collections of *Y. brevifolia*, it would be interesting to know whether the variety or typical plant was found in this region by the Whipple Expedition; it extends northward in California and crosses into Nevada in the Spring Mt. Range and is found on both sides of the Charleston Mts.; from these regions it continues northeastward, perhaps mingled with the typical plant, into extreme southwestern Utah. In Tidestrom's *Flora of Utah and Nevada* is a picture (t. 12) of the "Joshua-Tree Association, Lincoln Co., Nevada." The caption states "The trees here shown are near their northern limit and are relatively small;" in the writer's opinion the picture is an excellent one of the dwarf variety; while the Las Vegas — St. George route passes close to southeastern Lincoln Co. (and the

photograph may have been taken near this region), yet the county is large and the variety may extend much further north; Goldfield, where the typical plant certainly occurs, lies far to the east, in Esmeralda Co.

Of the flora along the road to Cima, lying west of the southern end of the New York Mts., California, Mary Beal (Madrño, 2: no. 5, 42. 1931) wrote: "From the summit [above Halloran Springs] to Cima we met many new things: first of all we marveled at the joshua forest, the largest we had ever found in the desert — at least 12 miles in length and several miles wide — I believe eight or ten miles in places, and I think it joins the forest that stretches from the summit to a few miles above Halloran Springs. The one thing most noticeable about it was the habit of growth, the trees did not spread out their branches and make bushy trees like Mr. Hemis's 'apple orchard' at Coolgardie, at least few of them did. Their branches are strongly ascending." This reference describes well the different appearance of the variety and typical plant, the Coolgardie region lying considerably west of the range of the variety; the writer has not been on the Cima road but Mr. Jaeger marked the variety on a map in this very region. To the Beal article Dr. Jepson added several footnotes; of the 'apple orchard' he stated: "A reference to the grove of very remarkable and large trees of this species on the Coolgardie yucca mesa in the Calico Mountains;" and of the Joshua Forest about Cima, "This is a very remarkable forest and doubtless the largest in California. The great desert valley which lies between the southerly extension of the Shadow Mountains and the Ivanpah Mountains is filled from side to side with it. Thence it extends westerly over the ridge to Halloran Springs, easterly over the pass by Kessler Peak into the Ivanpah Valley about Cima. East of Yucca Grove station, one leaves the main road at Windmill road station on the broad valley floor and turns southerly. One now begins to get an increasingly impressive idea of the vastness of this yucca forest as he goes on. The slope ascends almost imperceptibly until one attains a summit between two peaks, Kessler Peak on the left, a prominent point in Ivanpah Mountains, and Teutonia Peak to the right. On the downward slope, easterly, into the Ivanpah Valley, the yucca trees are denser than I have ever seen them elsewhere — as one looks through the forest along the slope the trunks finally close the view, filling completely the vista. Everywhere else I have been able to look quite through a yucca forest to a further background. In the Ivanpah Valley the forest extends for a long distance north and south. Its limits have not as yet been defined."

PLATES

- I. *YUCCA FAXONIANA* (Trel.) Sargent (See p. 18).
Between Sierra Blanca and Indian Hot Springs, Hudspeth Co., Texas. April 28, 1931. Plant in center foreground is a *Dasyllirion* sp.
- II. *YUCCA FAXONIANA* (Trel.) Sargent
Between Sierra Blanca and Indian Hot Springs, Hudspeth Co., Texas. April 28, 1931. Plant, including inflorescence, 6 m. in height. Note hemispherical heads of leaves and structure of inflorescence.
- III. *YUCCA FAXONIANA* (Trel.) Sargent
South of Sierra Blanca, Hudspeth Co., Texas. April 28, 1931. Plant, including inflorescence, 3 m. in height; plants at right and left are *Dasyllirion* sp.
- IV. *YUCCA FAXONIANA* (Trel.) Sargent
Indian Hot Springs road not far south of Sierra Blanca, Hudspeth Co., Texas. April 28, 1931. *McKelvey 2054*. Inflorescence proper 1 m. in length.
- V. *YUCCA FAXONIANA* (Trel.) Sargent
Indian Hot Springs road, not far south of Sierra Blanca, Hudspeth Co., Texas. April 28, 1931. *McKelvey 2053*. Flowers 6.5–7.5 cm. in length.
- VI. *YUCCA CARNEROSANA* (Trel.) McKelvey (See p. 24).
South of Persimmon Gap, on road from Marathon to Boquillas, Brewster Co., Texas. April 24, 1931. *McKelvey 1959*. Plant, including inflorescence, 4.5 m. in height.
- VII. *YUCCA CARNEROSANA* (Trel.) McKelvey
South of Persimmon Gap, on road from Marathon to Boquillas, Brewster Co., Texas. April 24, 1931. *McKelvey 1960*. Plant, including inflorescence 5.5 m. in height. Bark is usually hidden by reflexed dead leaves to the ground.
- VIII. *YUCCA BACCATA* Torrey (See p. 30).
Granite Dells, near Prescott, Yavapai Co., Arizona. April 25, 1932. Note broad, concavo-convex leaf-blades.
- IX. *YUCCA BACCATA* Torrey
Road to Charleston Park, Charleston Mts., Clark Co., Nevada. May 2, 1934. Inflorescence will elongate and broaden somewhat. Compare with PLATE XIV.
- X. *YUCCA BACCATA* Torrey
South end of Raton Pass, Colfax Co., New Mexico. May 31, 1934. *McKelvey 4863*. Note how the broad leaf-blade is often twisted near the middle.
- XI. *YUCCA BACCATA* Torrey
About 14 miles west of Sanderson, Pecos (?) Co., Texas. April 21, 1931. *McKelvey 1909*. Flowers on plant at left varied greatly in form from those on group at right.
- XII. *YUCCA BACCATA* Torrey
North end of Raton Pass, Las Animas Co., Colorado. May 31, 1934. *McKelvey 4865*. Note long pistil with upward-tapering ovary, short oblong-cylindric style and erect stigmas; flowers 10.25–12.75 cm. in length.
- XIII. *YUCCA BACCATA* Torr. var. *VESPERTINA* McKelvey (See p. 45).
Just east of Peach Spring, Mohave Co., Arizona. May 12, 1931. *McKelvey 2167*; **type**. A single clump composed of 25 or more heads of leaves.
- XIV. *YUCCA BACCATA* Torr. var. *VESPERTINA* McKelvey
Road to Charleston Park, Charleston Mts., Clark Co., Nevada. May 2, 1934. *McKelvey 4134*. Compare with PLATE IX.
- XV. *YUCCA BACCATA* Torr. var. *VESPERTINA* McKelvey
North of Kanab, Kane Co., Utah. May 10, 1934. Somewhat intermediate between typical plant and variety; note persistent dried flowers.

- XVI. *YUCCA CONFINIS* McKelvey (See p. 49).
About 14 miles northeast of Douglas, Cochise Co., Arizona. May 3, 1931. *McKelvey 2099*; type. Inflorescence about 1 m. in height; note that the flowering portion is only exerted for about half its length; note also flexuous scape.
- XVII. *YUCCA CONFINIS* McKelvey
About 14 miles northeast of Douglas, Cochise Co., Arizona. July 27, 1935. *McKelvey 4966*. Note that inflorescence is mainly racemose with only a few short branchlets near top of rhachis.
- XVIII. *YUCCA CONFINIS* McKelvey
About 14 miles northeast of Douglas, Cochise Co., Arizona. July 27, 1935. *McKelvey 4966*. Fruit approximately natural size. Note that the filament, now reflexed, is free from those adjacent at insertion.
- XIX. *YUCCA ARIZONICA* McKelvey (See p. 53).
Between Santa Cruz River and Nogales, Santa Cruz Co., Arizona. May 3, 1931. Note that inflorescence proper is exerted for its entire length beyond the leaves and branched from base to racemose tip. Plant 4 m. in height including inflorescence.
- XX. *YUCCA ARIZONICA* McKelvey
Near Patagonia, Santa Cruz Co., Arizona. April 18, 1932. Plant in right foreground is a *Dasy-lirion* sp.
- XXI. *YUCCA ARIZONICA* McKelvey
Between Santa Cruz River and Nogales, Santa Cruz Co., Arizona. May 3, 1931. *McKelvey 2120*. Looking into the top of a single clump. Inflorescence proper 1 m. in length and exerted for its entire length beyond the leaves.
- XXII. *YUCCA ARIZONICA* McKelvey
Between Santa Cruz River and Nogales, Santa Cruz Co., Arizona. July 22, 1935. Plant over 7 m. in breadth.
- XXIII. *YUCCA ARIZONICA* McKelvey
Detail of PLATE XXII. Note how leaf-clusters often flatten out in the center.
- XXIV. *YUCCA ARIZONICA* McKelvey
Just north of Patagonia, Santa Cruz Co., Arizona. July 22, 1935. *McKelvey 4962*. Fruit about 15 cm. in length. Note collar-like band into which the filaments, now reflexed, are united at insertion.
- XXV. *YUCCA THORNBURI* McKelvey (See p. 58).
Rincon Mts., Pima Co., Arizona. March 19, 1930. *McKelvey 1585*. Note long branchlets of inflorescence and that inflorescence proper is only exerted for about half its length beyond the foliage.
- XXVI. *YUCCA THORNBURI* McKelvey
Rincon Mts., Pima Co., Arizona. March 27, 1929. *McKelvey 1627*; type. (Inflorescence from plant shown in pl. 138 of Jour. Arnold Arb. 16: 1935)
- XXVII. *YUCCA THORNBURI* McKelvey
Near Vail, Pima Co., Arizona. March 19, 1930. *McKelvey 1570*.
- XXVIII. *YUCCA THORNBURI* McKelvey
Mt. Lemmon road, Santa Catalina Mts., Pinal Co., Arizona. July 19, 1935. *McKelvey 4961*. Fruit 22.5 cm. in length.
- XXIX. *YUCCA* species (See p. 63).
Road to Sunflower Mine, Mazatzal Range, Gila Co., Arizona. May 6, 1929. *McKelvey 931*. Plant suggestive of *Y. arizonica* but not conforming throughout to that species.
- XXX. *YUCCA* species
Road to Sunflower Mine, Mazatzal Range, Gila Co., Arizona. May 15, 1929. *McKelvey 1040*. Fruit about 20.25 cm. in length.
- XXXI. *YUCCA TRECULEANA* Carrière (See p. 69).
About 18 miles south of San Antonio on road to Corpus Christi, Bexar Co., Texas. April 5, 1932. *McKelvey 2611*. Young plant producing two inflorescences.

- XXXII. *YUCCA TRECULEANA* Carrière
Between Roma and Zapata, Starr Co. or Zapata Co., Texas. April 9, 1931. *McKelvey 1780*. Inflorescences very similar to what is found in the cultivated plant.
- XXXIII. *YUCCA TRECULEANA* Carrière
Between Mission and Rio Grande City, Hidalgo Co. or Starr Co., Texas. April 9, 1931. Plant, including inflorescence, about 5 m. in height.
- XXXIV. *YUCCA TRECULEANA* Carrière
Near San Cristoval Creek north of Mathis, San Patricio Co., Texas. April 5, 1931. *McKelvey 1704*. Form of inflorescence and of flower very similar to what is found in the cultivated plant.
- XXXV. *YUCCA TRECULEANA* Carrière
Point Isabel, Cameron Co., Texas. April 8, 1931. *McKelvey 1765*. Fruit-cluster about 1 m. in length; fruit shows more distortion than commonly; note persistent bracts and corolla-segments.
- XXXVI. *YUCCA TRECULEANA* Carrière
Stonewall, Gillespie Co., Texas. April 8, 1932. *McKelvey 2616*. Largest single-stemmed specimen seen in Texas; 30 inflorescences were counted.
- XXXVII. *YUCCA TRECULEANA* Carr. var. *SUCCULENTA* McKelvey (See p. 80).
Just east of Hondo, Medina Co., Texas. April 2, 1932. *McKelvey 2600*; type. Plant, including inflorescence, a little over 2 m. in height.
- XXXVIII. *YUCCA TRECULEANA* Carr. var. *SUCCULENTA* McKelvey
Inflorescence of plant shown in PLATE XXXVII. Compare with PLATE XXXIV and note difference in form of the inflorescence and in the number of flowers.
- XXXIX. *YUCCA TRECULEANA* Carr. var. *SUCCULENTA* McKelvey
Road to Corpus Christi, about 18 miles south of San Antonio, Bexar Co., Texas. April 5, 1932. *McKelvey 2610*. Note slender, ellipsoidal inflorescence which will elongate still further.
- XL. *YUCCA SCHOTTII* Engelmann (See p. 82).
Near Oracle, Santa Catalina Mts., Pinal Co., Arizona. May 25, 1929. *McKelvey 1130*. Note stem inclining from base.
- XLI. *YUCCA SCHOTTII* Engelmann
South of Oracle on Mt. Lemmon road, Santa Catalina Mts., Pinal Co., Arizona. March 21, 1930. *McKelvey 1620*. Plant, including inflorescence, between 4 and 5 m. in height; the single stem is unusual. Note structure and position, in relation to foliage, of inflorescence.
- XLII. *YUCCA SCHOTTII* Engelmann
North of Sonoita, Santa Cruz Co., Arizona. July 22, 1935. *McKelvey 4963*. Note stems inclining from base.
- XLIII. *YUCCA SCHOTTII* Engelmann
Inflorescence of plant shown in PLATE XLII.
- XLIV. *YUCCA SCHOTTII* Engelmann
Rucker Canyon, Chiricahua Mts., Cochise Co., Arizona. July 28, 1935. *McKelvey 4967*.
- XLV. *YUCCA SCHOTTII* Engelmann
White House Canyon, Santa Rita Mts., Pima Co., Arizona. July 20, 1935. *McKelvey 4965*. Fruit 9–11.5 cm. in length; note its asymmetrical form.
- XLVI. *YUCCA SCHIDIGERA* Roezl (See p. 92).
Cerbat Mts., Mohave Co., Arizona. April 1, 1930. *McKelvey 1659–1*. Inflorescences very similar to those found throughout the plant's range; one stem less common than several.
- XLVII. *YUCCA SCHIDIGERA* Roezl
Inflorescence of plant shown in PLATE XLVI. Note densely flowered inflorescence and small globose flowers.
- XLVIII. *YUCCA SCHIDIGERA* Roezl
Palms to Pines Highway, San Jacinto Mts., Riverside Co., California. February 27, 1936. *McKelvey 5060*. Inflorescence bud, 0.3 m. in length. Note how bracts on scape (with long leafy tips) change on inflorescence proper, becoming ultimately bract-like throughout.

- XLIX. *YUCCA SCHIDIGERA* Roezl
March 2, 1936. Inflorescence bud of PLATE XLVIII five days later; inflorescence now 0.5 m. in length. Note small papery bracts protecting the individual flowers.
- L. *YUCCA SCHIDIGERA* Roezl
Pass between Morongo and Yucca Valleys, San Bernardino Co., California, April 28, 1932. *McKelvey 2719*.
- LII. *YUCCA SCHIDIGERA* Roezl
Pass between Morongo and Yucca Valleys, San Bernardino Co., California. April 28, 1932. *McKelvey 2718*. Note great number of fruits and their asymmetrical form.
- LIII. *YUCCA TORREYI* Shafer (See p. 104).
Near Limpia Creek, Jeff Davis Co., Texas. April 22, 1931. *McKelvey 1956*; **type**. Inflorescences about 1 m. in length.
- LIII. *YUCCA TORREYI* Shafer
Near Limpia Creek, Jeff Davis Co., Texas. April 22, 1931. Note elongated heads of leaves and that inflorescences are only exserted for about half their length.
- LIV. *YUCCA TORREYI* Shafer
Five miles north of Presidio, Presidio Co., Texas. April 26, 1931. Note elongated heads of leaves. Plant 6 m. in height.
- LV. *YUCCA TORREYI* Shafer
About five miles north of Presidio, Presidio Co., Texas. April 26, 1931. *McKelvey 2018*. Plant, including inflorescence, 6 m. in height. Note untidy appearance of the plant.
- LVI. *YUCCA TORREYI* Shafer
Fruit of plant shown in PLATE LV. Fruit 10.25–12.75 cm. in length. Note that the reflexed filaments, while at times overlapping, do not unite to each other at insertion.
- LVII. *YUCCA TORREYI* Shafer f. *PARVIFLORA* McKelvey (See p. 112).
West of Van Horn, Culberson Co., Texas. April 26, 1931. A moderately young plant; leaves are beginning to die and reflex on the lower portion of the stem.
- LVIII. *YUCCA TORREYI* Shafer f. *PARVIFLORA* McKelvey
Inflorescence of plant shown in PLATE LVII.
- LXIX. *YUCCA* species (See p. 114).
Region of Devil's River, Val Verde Co., Texas. April 19, 1931. Fruit and non-filiferous margins of leaves suggest *Y. Treculeana*; form and rigidity of leaves suggest *Y. Torreyi*.
- LX. *YUCCA* species
Region of Devil's River, Val Verde Co., Texas. April 19, 1931. Inflorescences suggest typical *Y. Treculeana*; foliage in form suggests *Y. Torreyi*; margins of leaves, in filiferous character, are intermediate between these species.
- LXI. *YUCCA* species
Inflorescence of plant shown in PLATE LX.
- LXII. *YUCCA BREVIFOLIA* Engelmann (See p. 119).
Yucca, Mohave Co., Arizona. March 15, 1932. Plant before a flower-cluster has been produced.
- LXIII. *YUCCA BREVIFOLIA* Engelmann
Yucca, Mohave Co., Arizona. March 15, 1932. Plant has produced one flower-cluster just above point where branches fork.
- LXIV. *YUCCA BREVIFOLIA* Engelmann
Yucca, Mohave Co., Arizona. March 15, 1932. *McKelvey 2543*. Inflorescence-bud. Note difference between bracts on scape (with leafy tip and bract-like base) and those on inflorescence proper.
- LXV. *YUCCA BREVIFOLIA* Engelmann
Yucca, Mohave Co., Arizona. March 15, 1932. *McKelvey 2533*. Expanding inflorescence. Note manner in which corolla-segments of inner row decurve near their tips and push apart the more flaccid segments of outer row.

- LXVI. *YUCCA BREVIFOLIA* Engelm
Yucca, Mohave Co., Arizona. March 15, 1932. *McKelvey 2540*. A pendent inflorescence. Note that bracts of inflorescence are now hidden by flowers.
- LXVII. *YUCCA BREVIFOLIA* Engelm
Yucca, Mohave Co., Arizona. March 15, 1932. *McKelvey 2539*. Inflorescence terminating a horizontal branch; the weight of the flowers is causing the rhachis to decurve.
- LXVIII. *YUCCA BREVIFOLIA* Engelm
Yucca, Mohave Co., Arizona. April 1, 1930. *McKelvey 1660*. Individual fruits 6.5–7 cm. in length. Note how bracts and old flowers fill crevices between the fruits.
- LXIX. *YUCCA BREVIFOLIA* Engelm
Yucca Valley, San Bernardino Co., California. April 28, 1932. Fruit similar in form to that of PLATE LXVIII, although line of primary dissepiments is more deeply angled.
- LXX. *YUCCA BREVIFOLIA* Engelm
East of Yucca in Sacramento Valley, Mohave Co., Arizona. April 1, 1930. Plant about 9 m. in height.
- LXXI. *YUCCA BREVIFOLIA* Engelm
South of Yucca, Mohave Co., Arizona. March 15, 1932. Plant 5.5–6 m. in height; the clump habit is unusual.
- LXXII. *YUCCA BREVIFOLIA* Engelm
Yucca Valley, San Bernardino Co., California. November 29, 1935. Plant 7.5 m. in height; note that crown becomes wide-spread and open in old specimens.
- LXXIII. *YUCCA BREVIFOLIA* Engelm
Inspiration Point, Riverside Co., California. December 16, 1935. This region is included in the new Joshua Tree National Monument; the trees here are of moderate age and still compact in form.
- LXXIV. *YUCCA BREVIFOLIA* Engelm. var. *JAEGERIANA* McKelvey (See p. 138).
Vicinity of Shadow Mts., San Bernardino Co., California. April 30, 1932. Compare with PLATES LXII and LXIII and note the more compact leaf-clusters of the variety.
- LXXV. *YUCCA BREVIFOLIA* Engelm. var. *JAEGERIANA* McKelvey
Vicinity of Shadow Mts., San Bernardino Co., California. April 30, 1932. Plant 4.5 m. in height.
- LXXVI. *YUCCA BREVIFOLIA* Engelm. var. *JAEGERIANA* McKelvey
Between Colorado River and Searchlight, Clark Co., Nevada. May 1, 1934. Tree about 4 m. in height. Note decurving rhaches.
- LXXVII. *YUCCA BREVIFOLIA* Engelm. var. *JAEGERIANA* McKelvey
Between Colorado River and Searchlight, Clark Co., Nevada. May 1, 1934. Tree about 6 m. in height, — the tallest of the variety seen by the writer. Note neatly reflexed dead leaves and tidy appearance of plant.
- LXXVIII. *YUCCA BREVIFOLIA* Engelm. var. *JAEGERIANA* McKelvey
Road to Charleston Park, Charleston Mts., Clark Co., Nevada. Alt. 1830 m. May 2, 1934. Tree 4 m. in height. All trees fruiting heavily.
- LXXIX. *YUCCA BREVIFOLIA* Engelm. var. *JAEGERIANA* McKelvey
Road to Charleston Park, Charleston Mts., Clark Co., Nevada. May 2, 1934. Note gummy exudations on fruit; also the open stigmatic tubes.
- LXXX. *YUCCA BREVIFOLIA* Engelm. var. *JAEGERIANA* McKelvey
Vicinity of Shadow Mts., San Bernardino Co., California. April 30, 1932. Adventitious shoots 20.25–30.5 cm. in length produced along an old branch.

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YUCCA FAXONIANA (Trel.) Sargent

PLATE II



YUCCA FAXONIANA (Trel.) Sargent



YUCCA FAXONIANA (Trel.) Sargent

PLATE IV



YUCCA FAXONIANA (Trel.) Sargent



YUCCA FAXONIANA (Trel.) Sargent

PLATE VI



YUCCA CARNEROSANA (Trel.) McKelvey



YUCCA CARNEROSANA (Trel.) McKelvey

PLATE VIII



YUCCA BACCATA Torrey



YUCCA BACCATA Torrey



YUCCA BACCATA Torrey



YUCCA BACCATA Torrey



YUCCA BACCATA Torrey



YUCCA BACCATA Torr. var. VESPERTINA McKelvey



YUCCA BACCATA Torr. var. VESPERTINA McKelvey



YUCCA BACCATA Torr. var. VESPERTINA McKelvey



YUCCA CONFINIS McKelvey



YUCCA CONFINIS McKelvey



YUCCA CONFINIS McKelvey



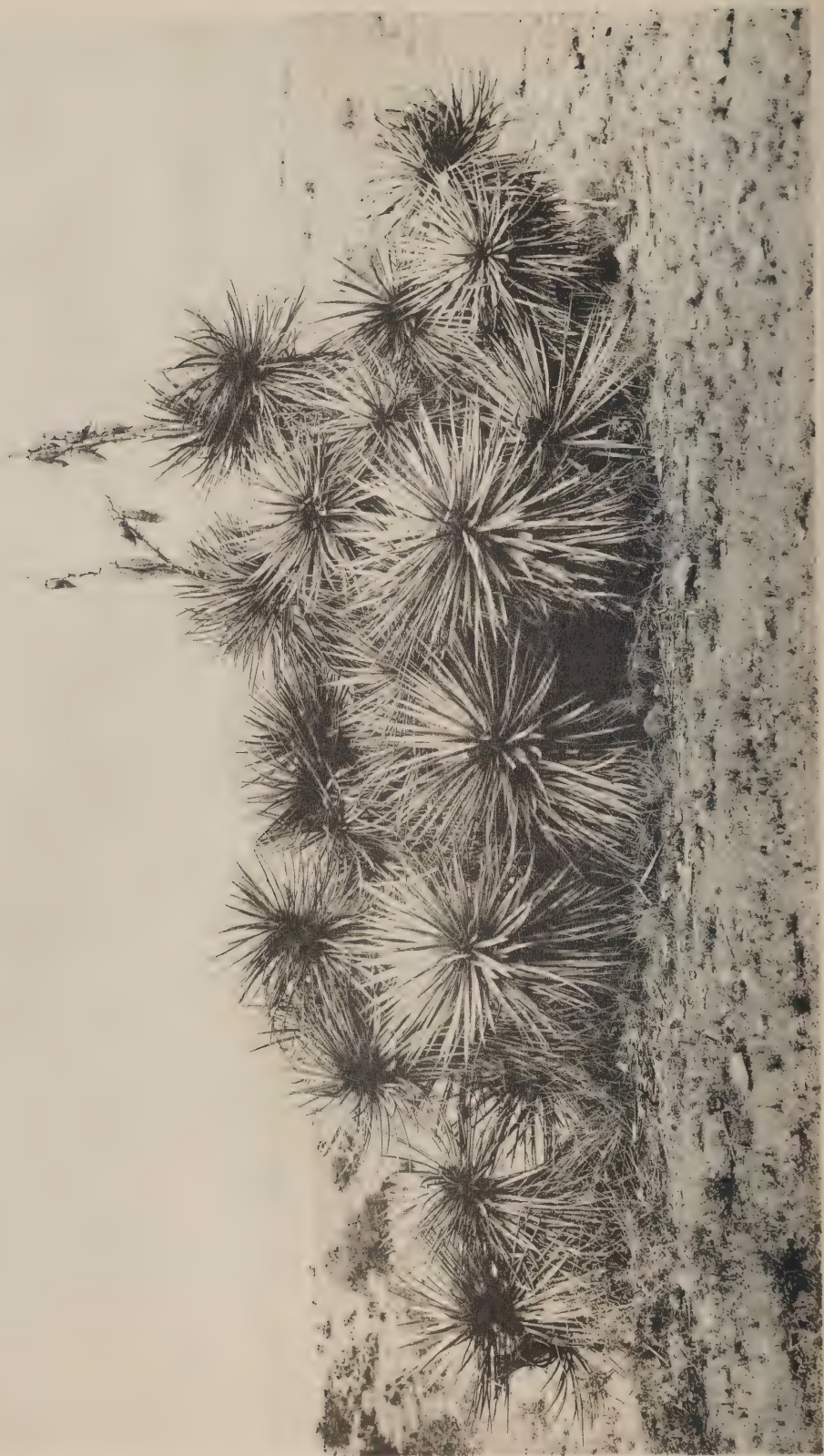
YUCCA ARIZONICA McKelvey



YUCCA ARIZONICA McKelvey



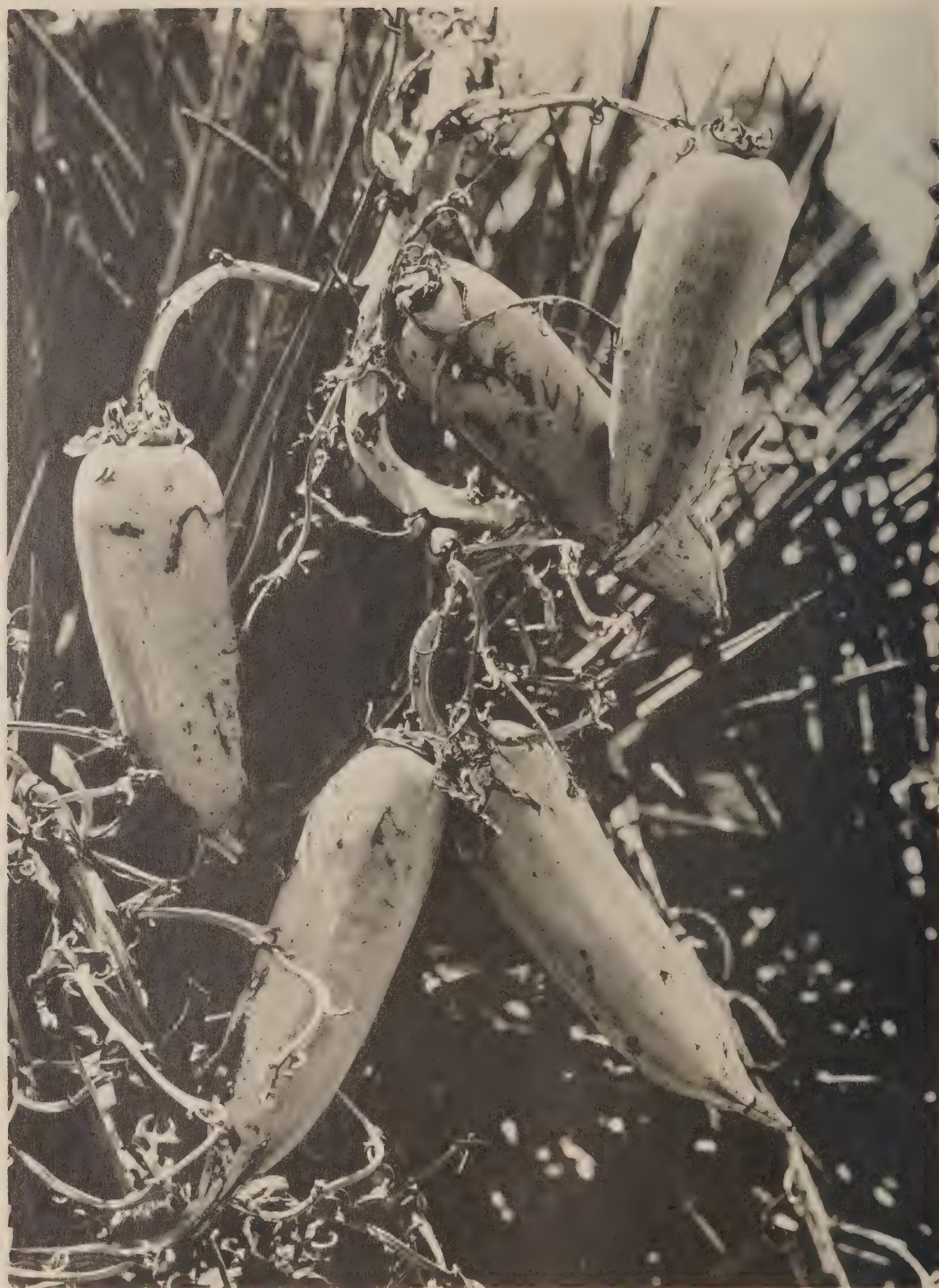
YUCCA ARIZONICA McKelvey



YUCCA ARIZONICA McKelvey



YUCCA ARIZONICA McKelvey



YUCCA ARIZONICA McKelvey



YUCCA THORNBERI McKelvey



YUCCA THORNERI McKelvey



YUCCA THORNBURI McKelvey



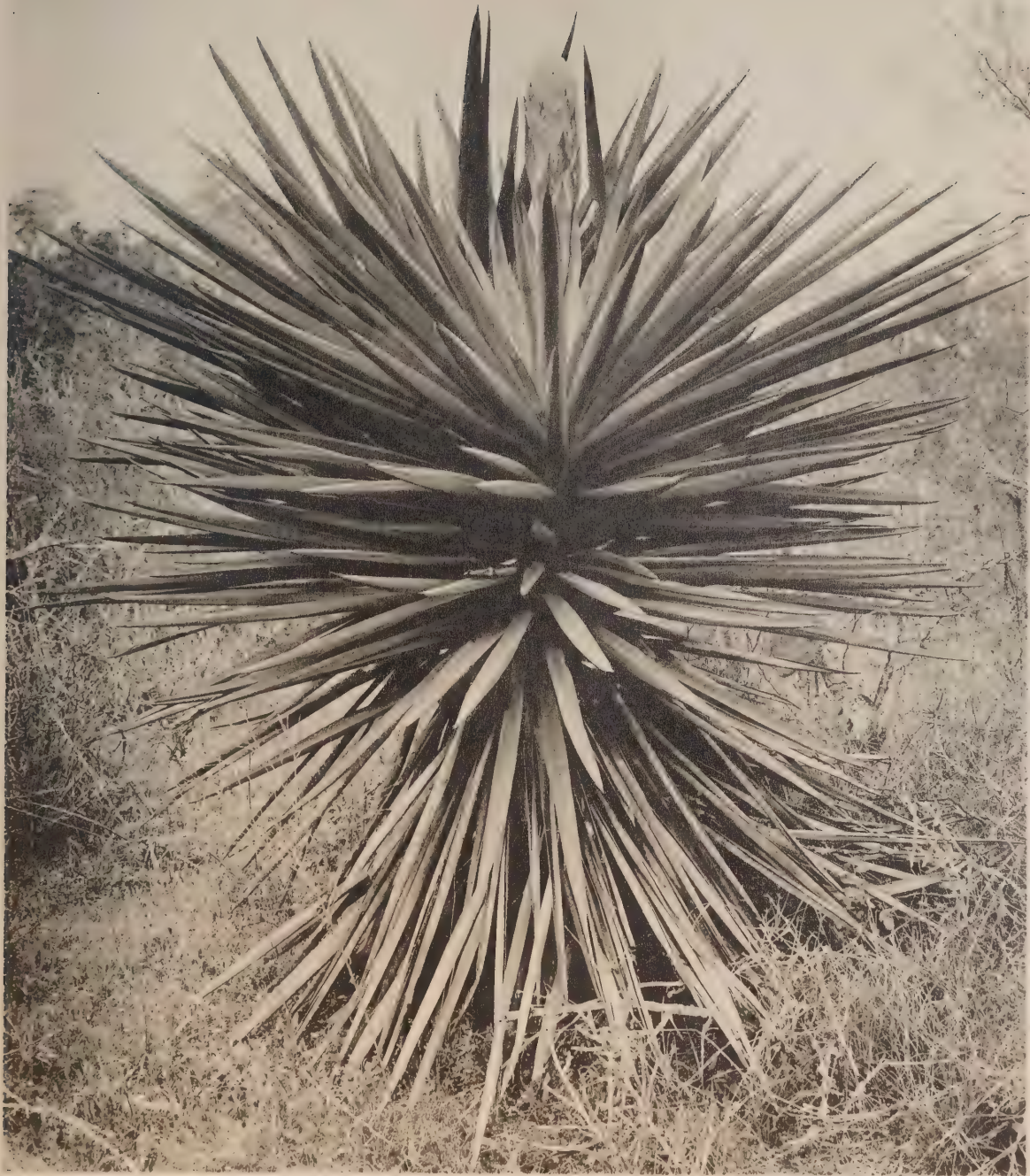
YUCCA THORNERI McKelvey



YUCCA species



YUCCA species



YUCCA TRECULEANA Carrière



YUCCA TRECULEANA Carrière



YUCCA TRECULEANA Carrière



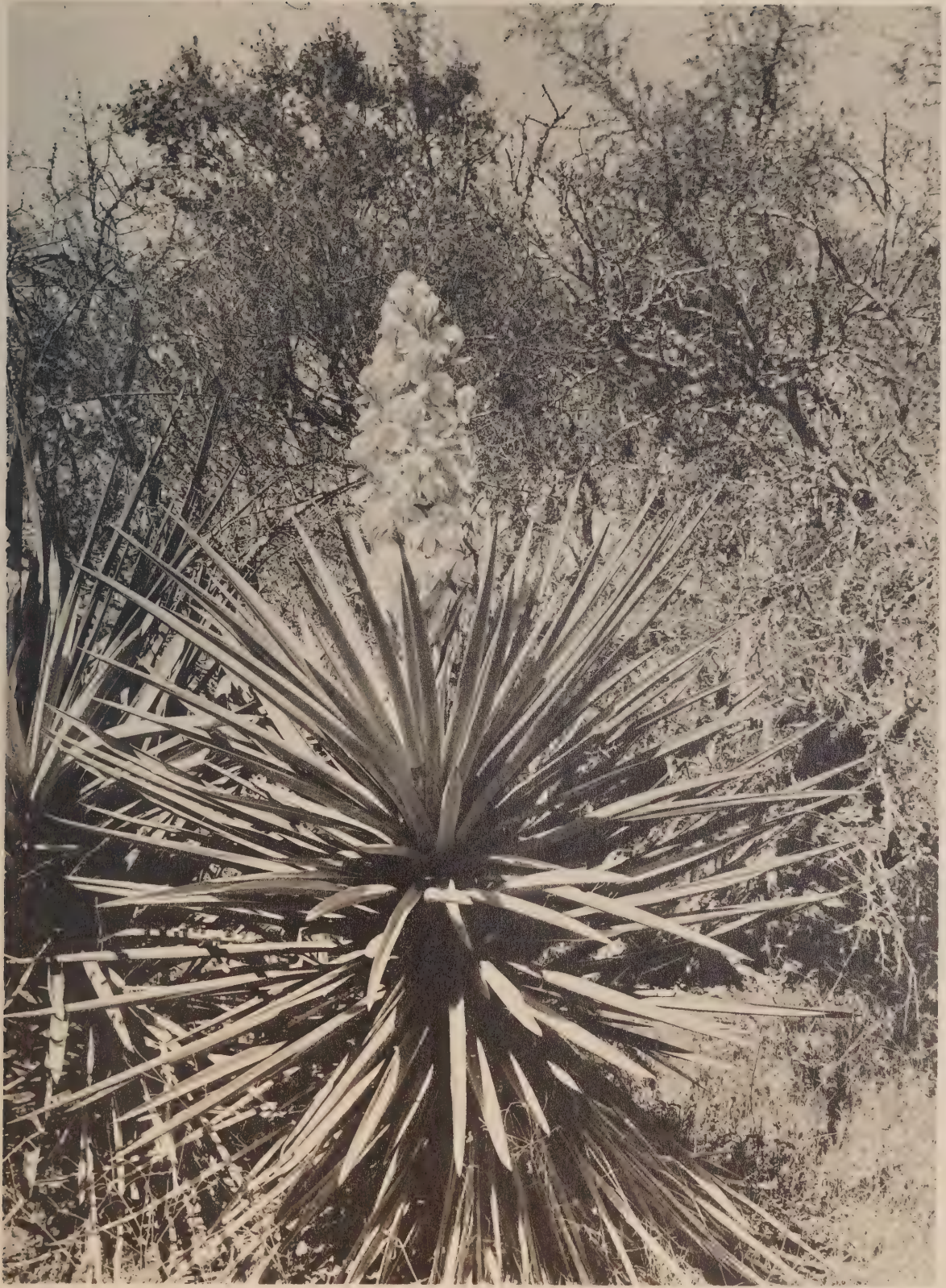
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YUCCA TRECULEANA Carrière



YUCCA TRECULEANA Carrière



YUCCA TRECULEANA Carr. var. SUCCULENTA McKelvey



YUCCA TRECULEANA Carr. var. SUCCULENTA McKelvey



YUCCA TRECULEANA Carr. var. SUCCULENTA McKelvey



YUCCA SCHOTTII Engelmann



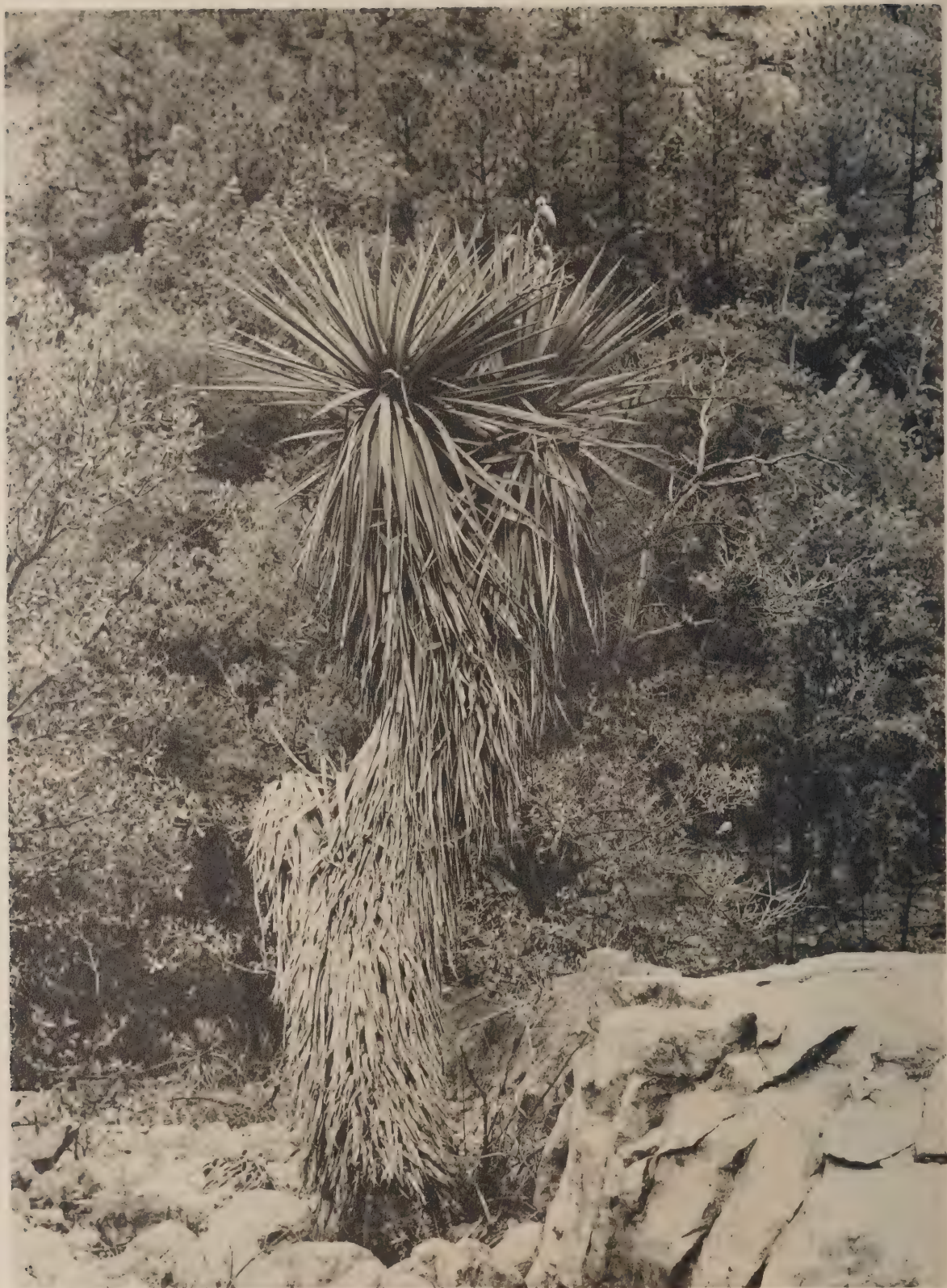
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YUCCA SCHOTTII Engelmann



YUCCA SCHOTTII Engelm.



YUCCA SCHOTTII Engelm.



YUCCA SCHOTTII Engelman



YUCCA SCHIDIGERA Roesl



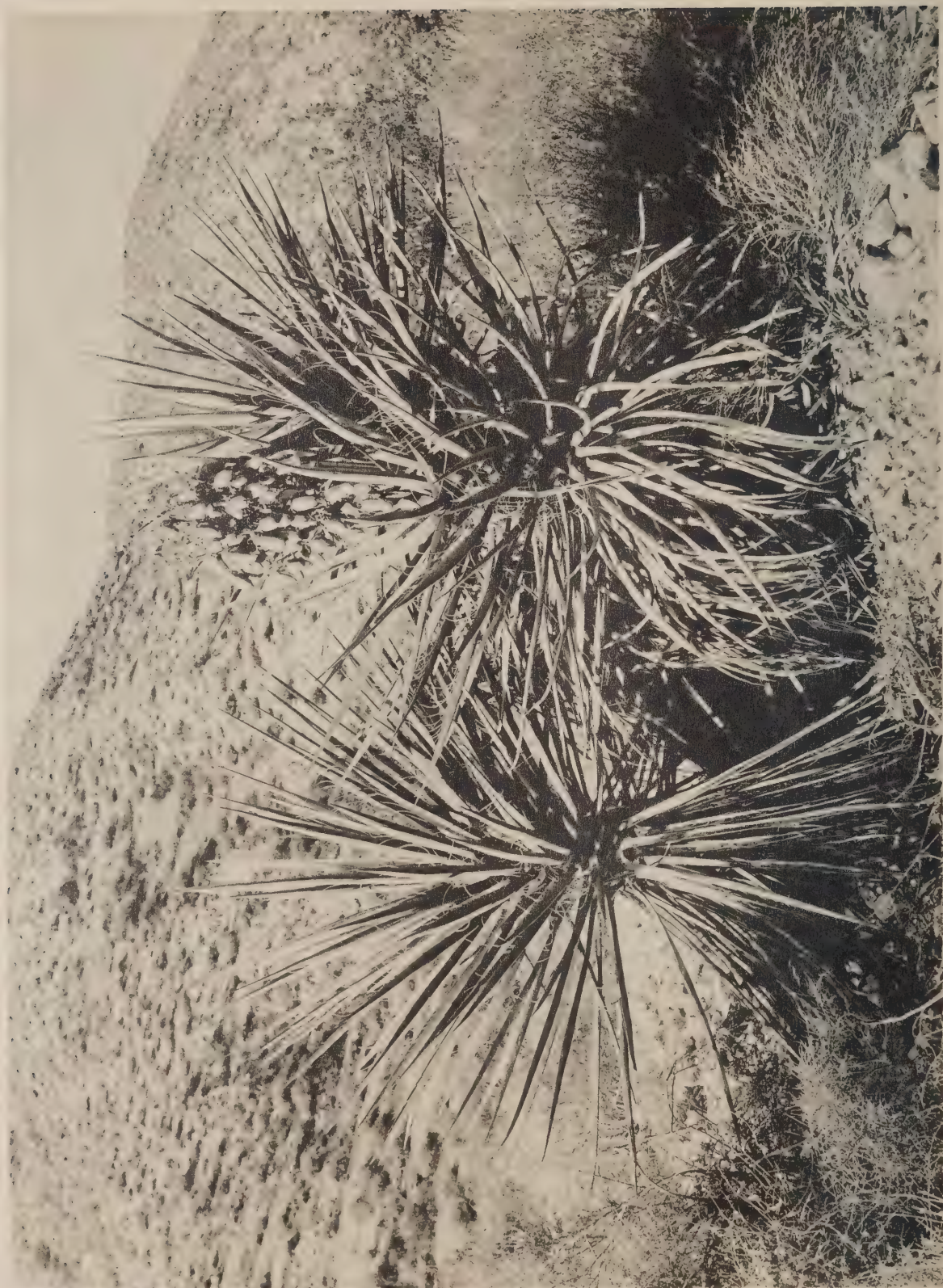
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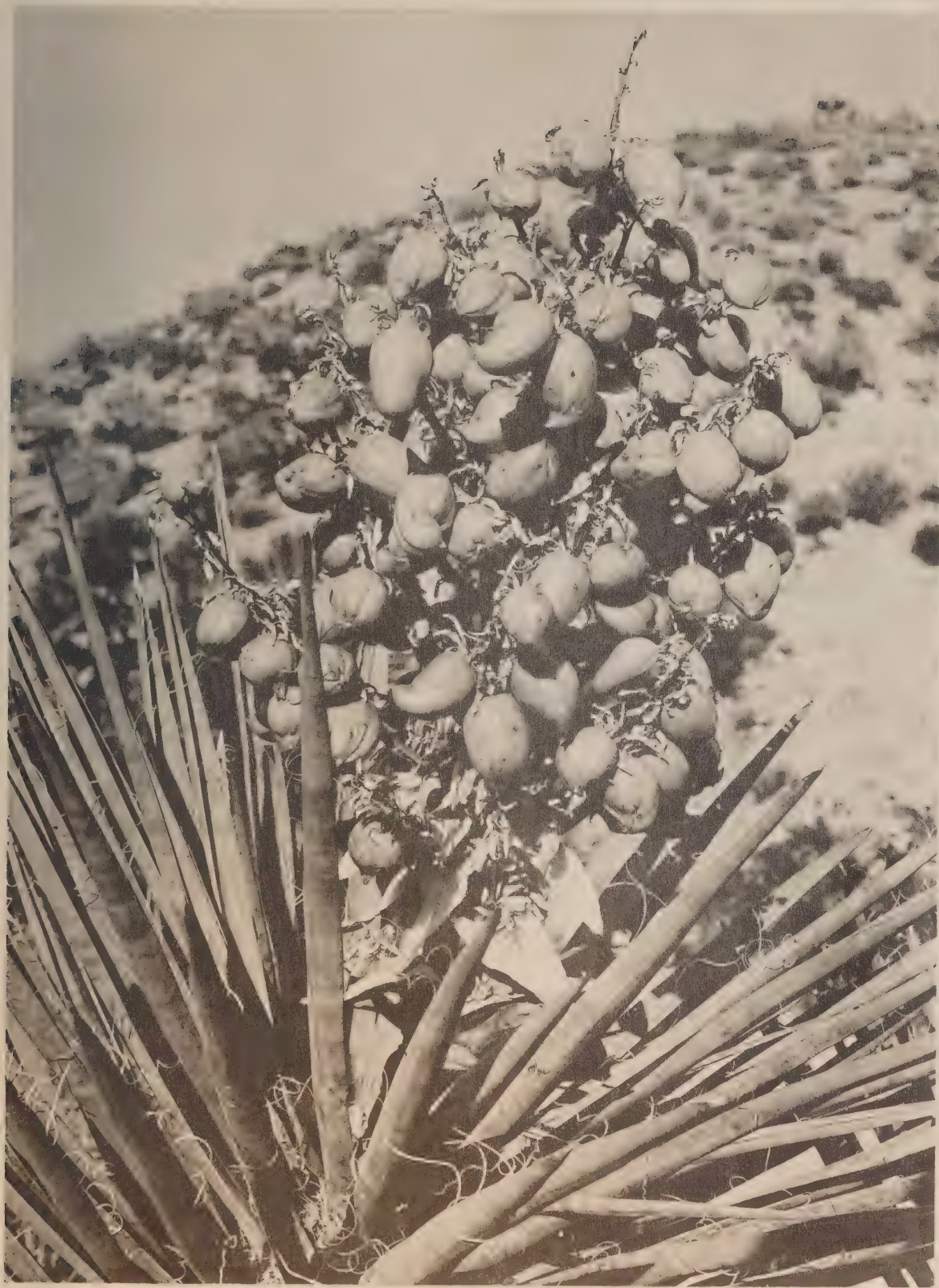
YUCCA SCHIDIGERA Roehl



YUCCA SCHIDIGERA Roehl



YUCCA SCHIDIGERA Roezl



YUCCA SCHIDIGERA Roehl



YUCCA TORREYI Shafer



YUCCA TORREYI Shafer



YUCCA TORREYI Shafer



YUCCA TORREYI Shafer



YUCCA TORREYI Shafer



YUCCA TORREYI Shafer f. PARVIFLORA McKelvey



YUCCA TORREYI Shafer f. PARVIFLORA McKelvey



YUCCA species



YUCCA species



YUCCA species



YUCCA BREVIFOLIA Engelm.



YUCCA BREVIFOLIA Engelm.



YUCCA BREVIFOLIA Engelm.



YUCCA BREVIFOLIA Engelm.



YUCCA BREVIFOLIA Engelmann



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YUCCA BREVIFOLIA Engelmann



YUCCA BREVIFOLIA Engelm. var. *JAEGERIANA* McKelvey



YUCCA BREVIFOLIA Engelm. var. *JAEGERIANA* McKelvey



YUCCA BREVIFOLIA Engelm. var. JAEGERIANA McKelvey



YUCCA BREVIFOLIA Engelm. var. JAEGERIANA McKelvey



YUCCA BREVIFOLIA Engelm. var. JAEGERIANA McKelvey



YUCCA BREVIFOLIA Engelm. var. *JAEGERIANA* McKelvey



YUCCA BREVIFOLIA Engelm. var. JAEGERIANA McKelvey

